JANUARY 2, 1961

missiles and rockets

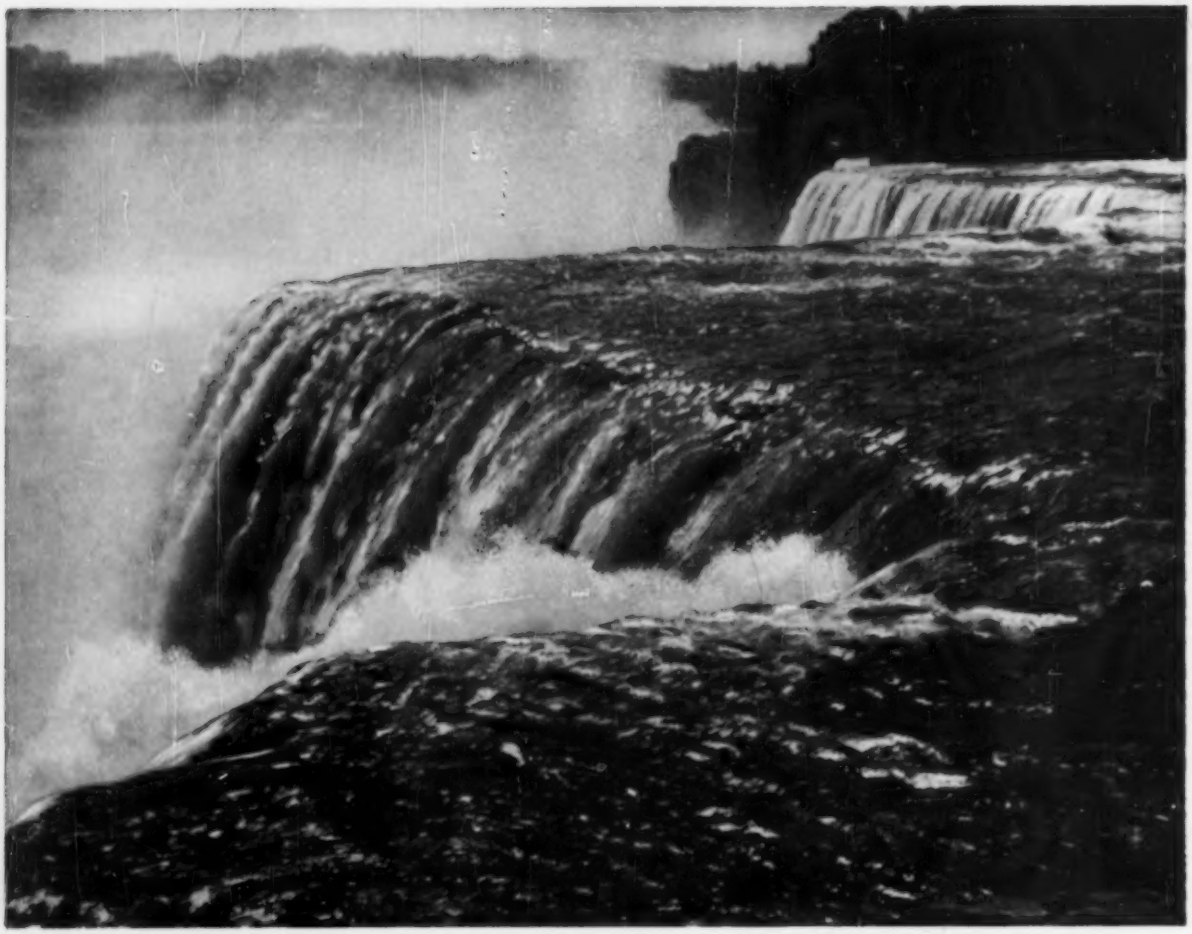
THE MISSILE/SPACE WEEKLY

DETROIT PUBLIC LIBRARY
JAN 4 1961
TECHNOLOGY DEPARTMENT

Helicopter Delivers Mercury Capsule to Carrier

Kennedy Starts Space Policy Overhaul 17
First Details of Mariner Guidance 17
Latest Edition of the M/R Astrolog 23

AN AMERICAN AVIATION PUBLICATION



The Avnet System

creates a new Concept of Supply

Avnet's supply of electronic components is vast. At this moment, for example, Avnet's total inventory of connectors is somewhere over 4¾ million. The Manufacturers whose lines Avnet assembles and/or makes available are in constant awareness of your present and future requirements. The Avnet System is geared to meet your demands of tomorrow, next month, next season, because unique Customer-Avnet-Manufacturer planning goes on daily.

This new Concept of an overwhelming Supply is one of many advantages in The Avnet System. *Avnet maintains a network of Sales Engineers traveling the U.S. Each engineer has his counterpart in a Service Center Expediter. Tremendous stocking facilities are maintained strategically throughout the country. Avnet maintains and operates complete assembly facilities for Connector Prototype requirements.* For the most reliable, most constant, steadiest source of Supply, contact your nearest Service Center in The Avnet System.

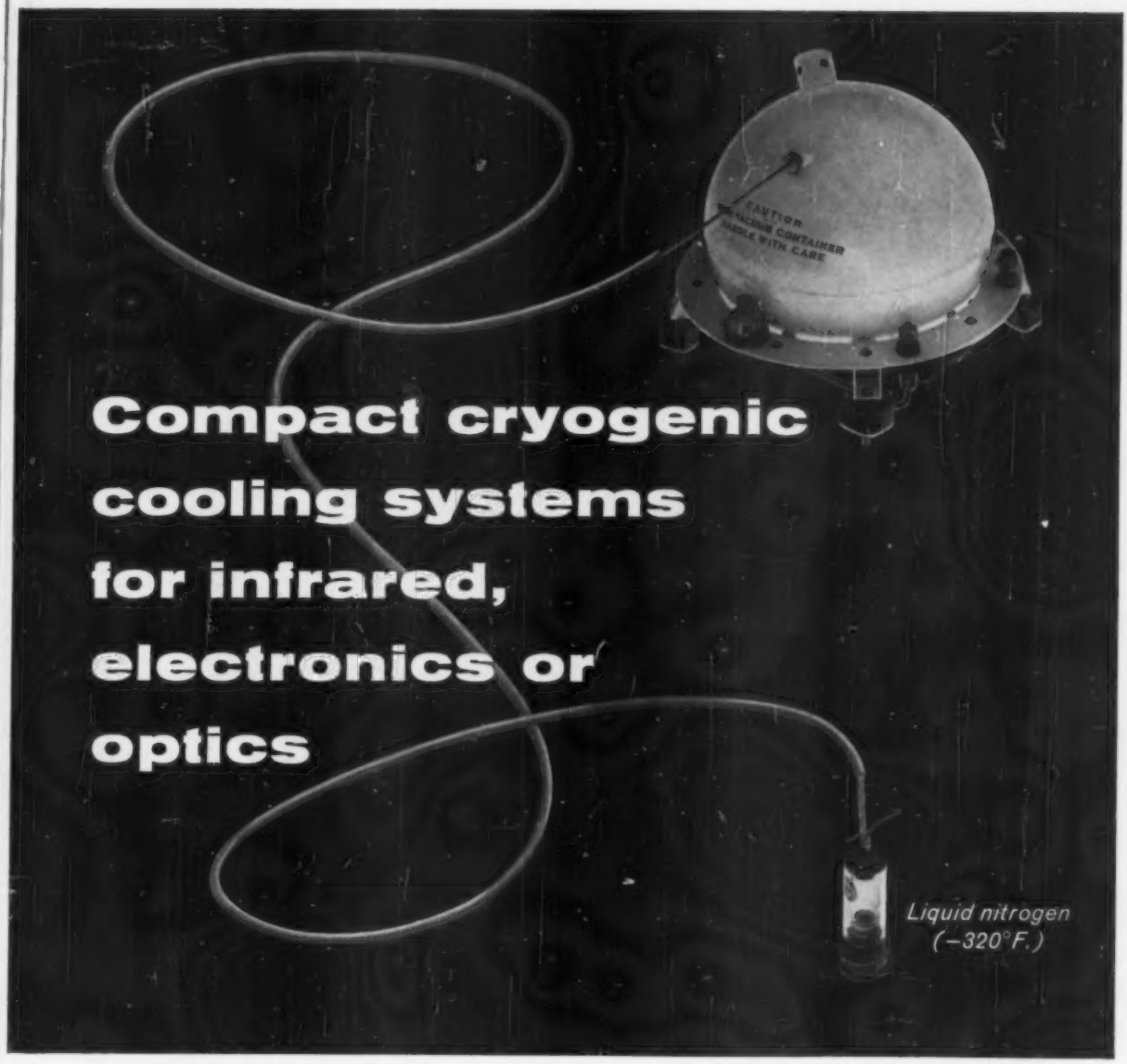
AVNET

THE AVNET SYSTEM
Men / Methods / Materials / Management
AVNET ELECTRONICS CORP.

Avnet Service Centers and Stocking Facilities are located in Los Angeles, Cal.; Sunnyvale, Cal.; Chicago, Ill.; Dayton, Ohio; Westbury, L. I.; Burlington, Mass.

Avnet distributes from its stocking facilities: BENDIX SCINTILLA CONNECTORS, SPERRY SEMICONDUCTORS, RHEEM SEMICONDUCTORS, ELECTROSNAP AND HETHERINGTON SWITCHES, GREMAR CONNECTORS, CLARE RELAYS, ROBERTSON SPLICE & CONNECTOR CASES, BABCOCK RELAYS, KING SUBMINIATURE HI-TEMP CERAMIC CAPACITORS, TIC PRECISION TRIMMERS, VIBREX FASTENERS by GENERAL TIRE & RUBBER CO., U.S. SEMCOR SEMICONDUCTORS, SANGAMO CAPACITORS, SPRAGUE CAPACITORS

Circle No. 3 on Subscriber Service Card.



New AiResearch system delivers nitrogen in liquid form from storage system to cooling area

Now units requiring cryogenic cooling no longer need be designed with allowances made for bulky expanders or adjacent storage tanks.

The new AiResearch system transfers the coolant *in liquid form* to a point of use *25 feet or more away*. The liquefied gas passes through an uninsulated, small, flexible tube which can be bent over and around obstructions. Because the storage system can be placed anywhere, space limitations are overcome and vehicle installation problems are simplified.

The complete system includes the cryogenic liquid container, pressure and flow controls, the liquid transfer tube and cooling adapter. The system can be operated without external power. It can be used with missile, aircraft, space or ground based units and can be converted to a closed-cycle system with the addition of a small gas liquefier.

AiResearch has pioneered many new developments in the cryogenic field. It is presently engaged in work on systems utilizing helium, hydrogen or neon as coolants, and cryogenic systems for zero G operation.

• *Please direct inquiries to Los Angeles Division.*

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

Systems and Components for: AIRCRAFT, MISSILE, SPACECRAFT, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

Circle No. 1 on Subscriber Service Card.

Latest Experimental Meteorological Satellite on Course, Thanks to Bell Scientists—to Aid in Weather Forecasting

THE DAY of operational weather satellites is one step closer with the orbiting of the National Aeronautics and Space Administration's Tiros II.

An on-the-job, working satellite, the TV-equipped Tiros II will take pictures of cloud cover and transmit them to earth for limited, experimental use in forecasting weather.

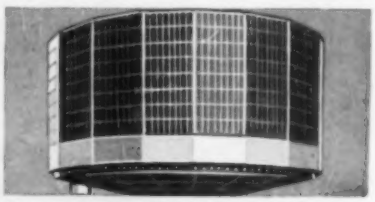
But despite its many instruments—TV cameras, tape recorders, solar cells and antennas—Tiros II would not be as useful if it were not in a nearly perfect circular orbit, made possible in large measure by the Bell Telephone Command Guidance System.

To provide accurate weather data, the satellite must be at an almost uniform distance from the earth at all times. Tiros II's orbit varies within extremely narrow limits as it constantly circles the earth.

Our Command Guidance System for the Tiros launching vehicle is a result of research and development by Bell Telephone Laboratories and production by Western Electric. This amazingly accurate system has scored many other successes in America's space program.

It has guided the successful Air Force Titan ICBM firings, and it helped make possible the first nose cone recoveries after flights of ICBM range. It also guided NASA's Tiros I and Echo I into their carefully planned orbits, and will be used in other forthcoming space probes and satellite launchings.

This Command Guidance System is one of a number of ways the Bell System is participating in the nation's space effort. The skills and knowledge called for in this pioneering activity are important assets in the country's defense.



More than 9000 solar cells—an invention of the Bell System—ring Tiros II and provide power for its instruments.

BELL TELEPHONE SYSTEM

Circle No. 2 on Subscriber Service Card.

A MISSILE / SPACE WEEKLY

missiles and rockets

Volume 8, No. 1 January 2, 1961

CLARKE NEWLON
Executive Editor

WILLIAM E. HOWARD
Managing Editor

James Baar .....Defense & Legislative
William Beller .....Engineering
Hal Gettings .....Electronics/GSE
Charles D. LaFond .....Electronics
Jay Holmes .....NASA
John F. Judge .....Advanced Materials
Reed Bundy .....News Editor
David Newman .....Copy Editor
James J. Haggerty ...Contributor, Industry Affairs
Dr. I. M. Levitt .....Contributor, Astrophysics
Michael Lorenzo .....Contributor, Propulsion
Dr. Albert Parry .....Contributor, Soviet Affairs
Dr. Hubertus Strughold Contributor, Space Medicine
G. V. E. Thompson, Michael Donne
Contributors, British Astronautics
Gwen Cammack, Heather David Editorial Assistants
William Martin .....Art Director
Bacil Guiley .....Assistant Art Director

BUREAUS
LOS ANGELES .....8929 Wilshire Boulevard
William J. Coughlin, Bureau Chief
Frank G. McGuire .....Propulsion
Richard van Osten
NEW YORK .....28 East 46th Street
PARIS .....11 Rue Condorcet
Jean-Marie Riche
GENEVA .....10 Rue Grenus
Anthony Vandyk

EDITORIAL ADVISORY BOARD
Dr. Peter Castruccio — Dr. Arthur Kantrowitz
Conrad H. Hoeppner — Dr. Eugen Saenger
Richard F. Gompertz — Robert P. Haviland
Alexander Satin — Vice Adm. Harry Sanders (ret.)

•

Edward D. Muhlfeld
Publisher

Paul B. Kinney .....Eastern Advertising Manager
James W. Claar ....Western Advertising Manager
Don Fullam .....Sales Promotion Manager
Patricia Behling .....Promotion Assistant
Eugene White .....Circulation Manager
John F. Walen .....Production Manager
Elsie Gray .....Advertising Service Manager
Barbara Barnett .....Production Assistant

Published each Monday with the exception of the last Monday in December by American Aviation Publications, Inc., 1001 Vermont Ave., N.W., Washington 5, D.C. Cable Address: AMERAV.

Wayne W. Parrish
President

Leonard A. Eiserer
Exec. Vice President and General Manager

Fred S. Hunter
Vice Pres. and Editorial Director

Richard Gibson
Director of Marketing

John N. Carlin
Director of Circulation

Printed at the Telegraph Press, Harrisburg, Pa. Second Class postage paid at Washington, D.C. and at additional mailing offices. Copyright 1961, American Aviation Publications, Inc. Subscription rates: U.S., Canada and Postal Union nations—1 year, $5.00; 2 years, $8.00; 3 years, $10. Foreign—1 year, $10.00; 2 years, $18.00; 3 years, $26.00. Single Copy rate—$.50. Subscriptions are solicited only from persons with identifiable commercial or professional interests in the missile/space industry. Subscription orders and changes of address should be referred to Circulation Fulfillment Mgr. M/R, 1001 Vermont Ave., N.W., Washington 5, D.C. Please allow 4 weeks for change to become effective and enclose recent address label if possible.

THE COVER

U.S. Marine helicopter which recovered the MR-1 Project Mercury spacecraft approaches deck of USS Valley Forge. For a report on the Mercury outlook, see story on Page 20.

JANUARY 2 HEADLINES

Kennedy Starts Overhaul of U.S. Space Policy 12
First Details of Guidance for NASA's Mariner 14
First Photos of Nike-Zeus Being Assembled 16
NASA Concerned by Atlas-based Launch Failures 17
Tiros-type Weather Satellite System Weighed 18
Report Urges Study of Space Impact on Mankind 18
Next Mercury Redstone Flight to Carry Chimpanzee .. 20
Martin Now Strictly a Missile/Space Business 37
Astropower Outlines Big Propulsion R&D Plans 39

SPACE MEDICINE

Martin Seeks to Keep Man Efficient in Space 19

SPECIAL SECTION

Latest Edition of M/R's Astrolog—An Up-to-Date Status Report on all U.S. missile and space programs and all satellites now in orbit 23

ELECTRONICS

Minuteman Flight Controls Aim at Low Maintenance .. 32
Cesium Beam Leading to Better Timing Accuracy 34
Raytheon Device Measures Composition of Gases .. 34
SOCOM Offers Improved Space Communications 35

ADVANCED MATERIALS†

TFE Resin Successfully Withstands Radiation 36

INTERNATIONAL

European Space Research Organization Due in Year .. 38

DEPARTMENTS

The Countdown 9
The Missile/Space Week† 17
Technical Countdown . 31
Industry 39
Products & Processes .. 41
Contracts 45
Names in the News .. 47
Letters 48
When and Where 49
Editorial 50

†U.S. Reg. Pdg.

32,369 copies this issue

The true scientist, the creative engi a

buy. Since this is a realistic world, money is an impor to

of attainment—does not begin and end with his eck

and creative climate—to rub elbows with men wh no

participant in the Great Adventure of Tomor es

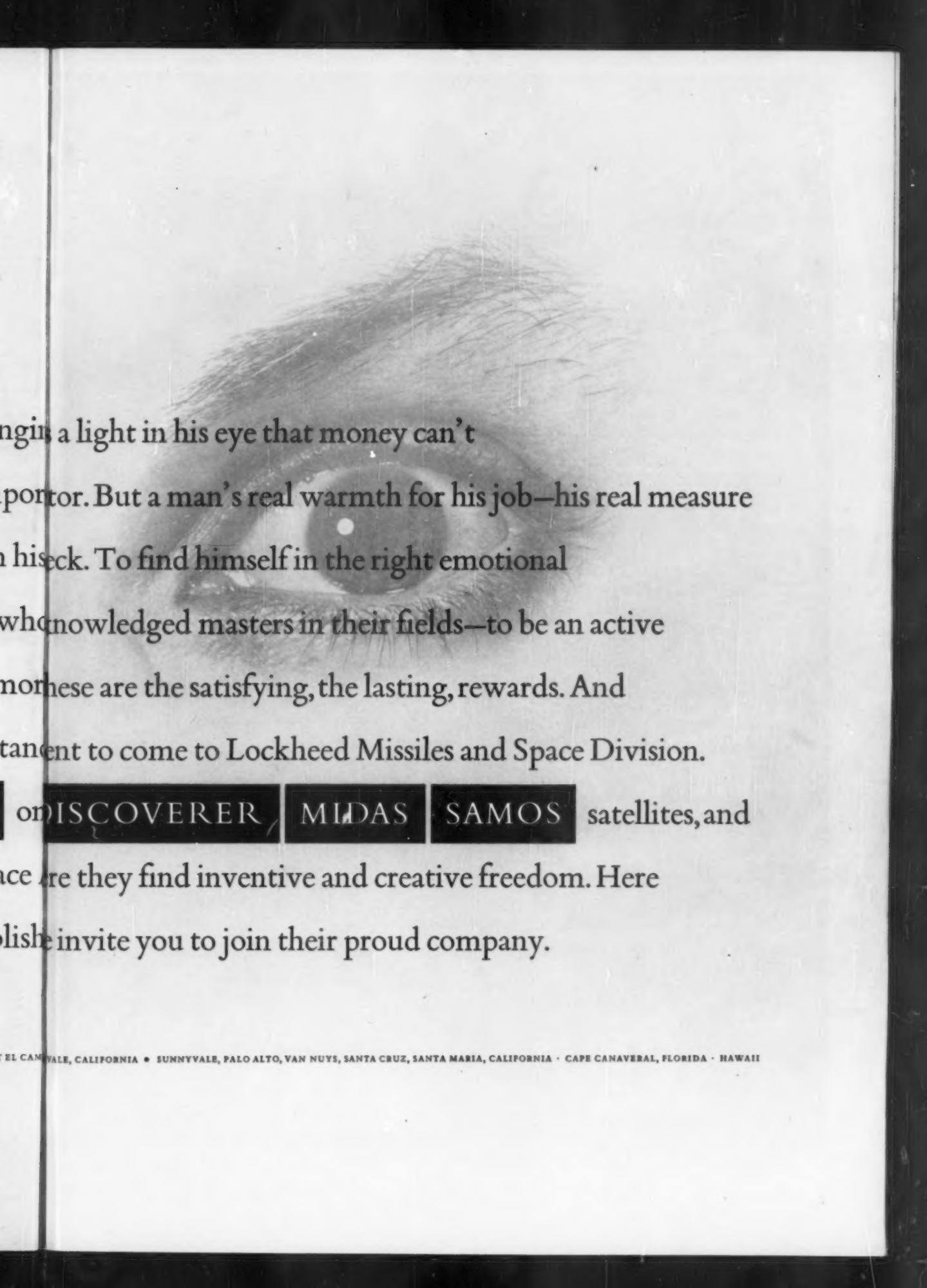
these rewards-within-rewards impel men of outstan ent

For here they can work on the POLARIS FBM on IS

on new, advanced contributions to the Space re

they find a sense of being, of doing, of accomplish in

Lockheed / MISSILES AND SPACE DIVISION DEPT. M-12A, 962 WEST EL CA VALE,



ngin a light in his eye that money can't
por tor. But a man's real warmth for his job—his real measure
n his eck. To find himself in the right emotional
who nowledged masters in their fields—to be an active
mor hese are the satisfying, the lasting, rewards. And
tan ent to come to Lockheed Missiles and Space Division.
on ISCOVERER MIDAS SAMOS satellites, and
ace re they find inventive and creative freedom. Here
lish invite you to join their proud company.

EL CAM VALE, CALIFORNIA • SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA · CAPE CANAVERAL, FLORIDA · HAWAII

From Aerojet's

TITAN

Propulsion for
TITAN, DYNA-SOAR,
ADVANCED PROJECTS

The missile: TITAN I, shown here in its first stage-separation flight. The power plants: liquid-propellant rocket-engines—designed, developed, and manufactured by Aerojet-General's Liquid Rocket Plant.

Supplier of engines for TITAN I and II, DYNA-SOAR, and BOMARC, the Liquid Rocket Plant is the nation's largest fully integrated facility for the research, development, and production of liquid rocket engines.

- In-Space Rocket Engines
- Large Boosters
- Pre-Packaged Liquid Rockets

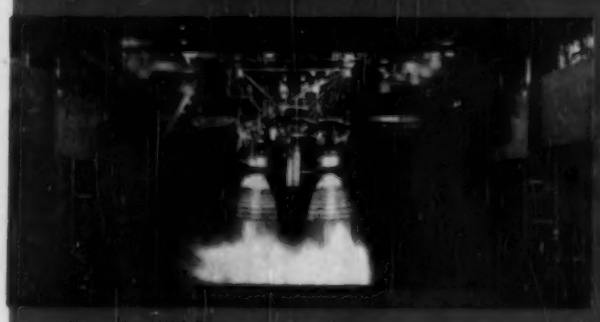
LIQUID ROCKET PLANT

Aerojet-General®

CORPORATION

SACRAMENTO, CALIFORNIA

A SUBSIDIARY OF THE GENERAL TIRE AND RUBBER COMPANY



Engineers, scientists—investigate outstanding opportunities at Aerojet

The Countdown

WASHINGTON

Mahon—More DOD Money

Indication of how Congress will handle the FY '62 DOD budget comes from Chairman George Mahon of the House Defense Appropriations subcommittee. Says Mahon: more should be spent on certain key missile and space programs the need for which the present administration has been a "little tardy" in recognizing. But, he is for a balanced budget and against any "vast new program of expenditures."

Kennedy Snub?

COUNTDOWN hears Chairman Overton Brooks of the House Space Committee is unhappy over not being invited to President-elect Kennedy's Palm Beach space conference. Insiders say Brooks may be "embarrassed" enough to make things difficult in the next session of Congress. What really irked him: Vice president-elect Johnson, after picking up the chairman-designate of the Senate Space Committee, Sen. Robert Kerr, in Oklahoma City, flew right over Brooks' home in Shreveport, La. Was the snub deliberate? Some politicos point out that it could have been—on grounds that Brooks was a less-than-enthusiastic Kennedy supporter during the campaign.

Discoverer Monkey Shot

Long-delayed first attempt to recover a monkey from orbit in a *Discoverer* capsule is now expected sometime in February. The monkey could go aboard *Discoverer XXI*, after one more shot in the series. *Discoverer XIX*, which was fired into orbit Dec. 19, was designed to test the new *Agena B* satellite and contained instrumentation to gather information on background radiation in support of the *Midas* IR missile detection satellite system.

Minuteman Shot Slips

First shot of a full scale *Minuteman* ICBM from a silo at the Cape has now slipped until late January or early February. It had been scheduled to go in December. But troubles developed with the GSE installation. The Air Force says the slippage will not affect the operational date of the first squadron, set for mid-1962.

Eisenhower Cuts

Both the Air Force and Navy claim their respective *Skybolt* and *Eagle* R&D programs are not being jeopardized by the cuts inflicted in the proposed Eisenhower DOD budget. The AF wanted $150 million for *Skybolt* in '62 and was knocked down to $80 million. (The whole R&D program for the ALBM is estimated at $400 million, of which $150 million is now programed through FY '62.) While the *Eagle* air-to-air missile itself may not be hurt, the Navy is pessimistic about saving the Missileer plane to carry it. Present indications are that the Eisenhower budget will eliminate the missileer altogether.

All-in-one ASP

Secret requirement the AF hopes to make stick in the proposed ASP (aerospace plane) is to make it a multi-mission spacecraft. This would include offensive, defensive, reconnaissance and logistic missions in space. The AF is seeking $20 million for ASP, a rocket-powered vehicle which can operate both in the atmosphere and in space.

What Race?

Will the U.S. be able to match the Soviet promise to set up a moon base on the 50th Anniversary of the Bolshevik Revolution—in 1967? The chances are slim, if one story is to be believed. It seems the Air Force laid out a step-by-step program to establish a lunar base by 1968. But, having no "mission" in space under Eisenhower policy, the AF offered the program to NASA. The result: NASA said, "Sorry—no money in the budget." As of now there is no funded U.S. plan to put a base on the moon.

INDUSTRY

Navy Moves on Hydrofoils

Proposals are due in about 60 days on the design and production of a 300-ton, 50-knot hydrofoil craft to be ready for testing in 24 months. Busships is expected to solicit proposals soon on a 500-ton hydrofoil in the 60-80 knot bracket.

AF Navy CB Funds Set

Surviving the wring-out in the Eisenhower FY '62 budget are funds for the AF and Navy to develop chemical and bacteriological warfare weapons. This has been generally an Army activity up to now, and the Army thought it was time someone else helped pick up the check.

Fight for Range Ship

Rough scramble is about to start on contracts for the $51.6 million job of converting and instrumenting two tracking ships for the Atlantic Missile Range. Several companies are in the competition. It's understood, incidentally, that bids will be reviewed carefully by DOD Research and Engineering.

INTERNATIONAL

A-Test for Tactical Missile

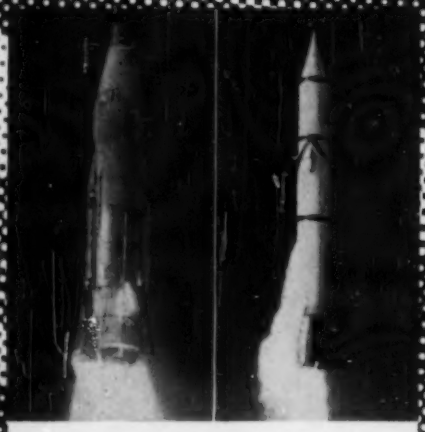
Best bet on the purpose of the third French A-test in the Sahara Dec. 27 is that it was to test an R&D warhead for a tactical missile. The atomic explosion was of low yield.

Soviet Underwater Missile Tracker

Intelligence sources are saying the Soviet survey ship "Shokalsky" in the Pacific is outfitted for tracking underwater missile launchings from Russian submarines. The ship put into Suva, Fiji, recently for repairs. It is the same one which recently fired some weather rockets.

Overseas Pipeline

Two infantry divisions of the Belgian army are being equipped with the French-made *Entac* anti-tank missile . . . Operational tests of the French *Masurca* anti-aircraft missile are due to begin in March. The missile is slated for sea duty in 1962 . . . There's still optimism in Britain that the *Blue Streak* will be used for space research, but France has all but thumbed down participation in a joint program using this booster.



The most proven large ballistic missiles, the Atlas (left) and Redstone (right), will launch America's Astronauts. Main-stage engines of both are by Rocketdyne.

AMERICA'S ASTRONAUTS WILL BE LAUNCHED INTO SPACE BY ROCKETDYNE ENGINES

America's man-in-space programs demand the ultimate in reliability. There is no room for error—that is why America's most experienced rocket engines have been chosen for the job.

And this means engines built by Rocketdyne.

A Redstone engine, whose performance over a decade of development includes 62 consecutive successful flights, will loft the first manned space craft high over the Atlantic in an exploratory ballistic arc.

Then an Atlas system of five engines, proven in more than 60 development and operational flights, will send a man soaring upward more than 100 miles to circle earth for four hours during man's first orbital flight in space.

To that dramatic moment, Redstone and Atlas will carry the heritage of more than 18,500 large engine tests at Rocketdyne's Propulsion Field Laboratory.

At every level of operation—from engineering to manufacturing to cost control—Rocketdyne has pioneered new concepts. Advanced management programs, combined with vast experience and the foremost high-thrust test facilities in the nation, give Rocketdyne the capability today to meet the challenges of tomorrow.

Rocketdyne engines have launched more than 250 missiles, satellites, and space probes.

FIRST WITH POWER FOR OUTER SPACE

ROCKETDYNE

DIVISION OF NORTH AMERICAN AVIATION

Canoga Park, California; Neosho, Missouri; McGregor, Texas

Cautious first steps . . .

Missile/Space Policy Changes Begin

Kennedy weighs problems of military space bid, nuclear strategy, space slippage; Johnson, Gilpatric named to key roles

by James Baar

PRESIDENT-ELECT KENNEDY appeared this week to be preparing to accelerate and strengthen the nation's missile and space programs. But the question of how far he would go and where still remained unanswered.

Among the issues involved in this overall question were:

–The military call for freedom to develop space weapons and greatly expand the military role in space.

–The size of NASA's space efforts and the slippage of America's only heavily financed man-in-space program, Project *Mercury*.

–The internal Pentagon conflict over the best nuclear strategy and its direct affect on the U.S. arsenal of big missiles—including R&D and procurement programs for both strategic ICBM's and active defense systems such as *Nike-Zeus*.

Related issues include possible resumption of U.S. nuclear testing and further tinkering with the organization of the Armed Forces.

How quickly and in what direction Kennedy moves in these areas will offer clear indications of whether he will fulfill his campaign pledges to expand greatly U.S. defense and space programs. The immediate indications were that in space activities, at least, he would move cautiously at first.

PRESIDENT-ELECT, Vice President-elect Johnson (center), named chairman of the Space Council, and Sen. Kerr, chairman-designate of Senate Space Committee.

• **Council upgraded**—Two of Kennedy's more potentially significant moves to date in this area are the appointments of Vice President-elect Lyndon Johnson as chairman of the National Space Council and Roswell Gilpatric as Deputy Defense Secretary.

The Space Council, originally proposed by the White House, was designed to aid the President in formulating overall policies for operations in space by the Pentagon and NASA. The nine-man Council includes the Secretaries of Defense and State, the AEC Chairman, the Administrator of NASA, one other member from within the government and three more from outside the government. Its composition could give it much force.

However, in practice, President Eisenhower used it little except as a rubber stamp for his space policies which authorized generally modest-scale activities by NASA and extremely limited activities by the military services. Last year, Eisenhower proposed that the Space Council be abolished.

The House approved the Eisenhower proposal, but Johnson, as Senate Majority Leader and Chairman of the Senate Space Committee, had the legislation pigeonholed. Johnson said in a statement in August:

"The next President could well have different views as to organization and functions of the military space programs. Any changes in the Space Act at this session will have little or no effect on the space programs during these next few months but could restrict the freedom of action of the next President."

• **Staff to grow**—Under the National Space Act, the principal function of the Council outside of aiding the President in determining national goals in space is to help determine which agency of the government will accomplish them. The Act authorizes the Council to employ a permanent staff headed by an executive secretary whose appointment must be confirmed by the Senate.

The executive secretary would be paid $20,000 a year. He could appoint without regard to Civil Service regulations three staff members. They could be paid $19,000 a year each. No such high-powered staff was ever appointed under the Eisenhower Administration.

However, Johnson could. He also could use the Council to help remold U.S. space policies and present roles and missions in space. The staff could be used to maintain a continuing survey of U.S. space activities to make certain that the new policies were being followed.

How bold a role Johnson actually would play remained to be seen. As Senate Majority Leader and Space Committee Chairman, he made a number of statements over the last several years deploring the U.S. Space Lag. However, despite his powerful position in a Democratic-controlled Congress, his committee never did more than tinker with the Administration's budget requests for NASA.

• **Duplication doubtful**—Another question raised by the Johnson appointment is what effect it might have on the technical advice the President presently receives from such review groups as the Office of the Presidential Scientific Adviser, the Office of the Defense R&E Director and the top technical officials at NASA.

There is the possibility the council could introduce another duplicating layer in the already many-layered government structure. But this need not happen if the Council staff remains small and restricts its activity to reviewing programs only for broad policy decisions.

It is precisely in this maze of many-layered government that Gilpatric may prove most helpful as the new No. 2 official in the Pentagon.

Ford President Robert S. McNamara, Kennedy's choice for Defense Secretary, is expected to provide both fiscal know-how and the imagination of a keen mind. But it is Gilpatric who, from his past tour of duty in the Pentagon as Air Force Undersecretary and subsequent study assignments, knows where many of the bodies are buried.

• **Easy on reorganization**—Gilpatric has been an outspoken critic of military duplication. He also helped Sen. Stuart Symington (D-Mo.) write the recent report calling for radical reorganization of the Pentagon.

However, no such radical reorganization appears to be in the offing, at least for some time. Kennedy has been most cool to the Symington recommendations. Few cheers have come from congressional leaders. And McNamara has stated flatly: "I will undertake no major reorganization of the Defense Department in the immediate future."

The prospect as the Kennedy Administration takes office is for some gradual readjustments in the Pentagon —possibly the elimination of some of the reviewers who review reviewers.

• **Sticky budget**—The defense budget, rather than reorganization, is the immediate main concern of Kennedy, McNamara and Gilpatric. The Eisenhower Administration is leaving them with parting defense budget carefully designed to cause them a maximum of fiscal embarrassment.

By repeated redrafting and causal reslicing, the Administration has put together a final overall budget for FY 1962 that will have the happy merit of being balanced.

However, to do this, military service requests have been cut to somewhat under $42 million by drastically holding down spending on a wide variety of programs aimed at giving the United States military superiority in the mid and late 1960's.

This budget, by Kennedy's standards as expressed during the election campaign, is no more adequate for rebuilding American power in the world than the last one. Its significance when Eisenhower sends it to Congress this month is mainly in its role as an indicator of Kennedy actions.

Kennedy is expected in some circles to increase the FY 1962 defense budget by $2 billion to $3 billion. He also may submit a sizable supplemental money bill for FY 1961. However, still more may be needed.

Two key factors are whether he reverses the Eisenhower Administration policy that the military have little business in space and which major missile and military space systems he decides the nation needs.

All are costly. But some are more costly than others. #

'Fine-tooth comb' readied . . .

The first details of any changes in U.S. space policies and programs under the Kennedy Administration are now expected to be disclosed in late January at the earliest.

President-elect Kennedy has ordered an exhaustive study of all current space programs and proposals at the Pentagon and NASA before deciding what changes he might make.

Vice President-elect Lyndon Johnson, newly named chairman of the National Space Council, is taking overall charge of the review.

Meantime, Johnson confined himself to predicting that Kennedy will launch a "very vigorous and accelerated space program."

He also added that presently planned spending on all U.S. space programs in FY 1962 would be about $2 billion and forecast it would rise to about $5 billion in FY 1965. He did not make clear whether the increases would come about quickly.

Kennedy conferred this last week at Palm Beach with Johnson and Sen. Robert Kerr (D-Okla.), the man expected to succeed Johnson as chairman of the Senate Space Committee.

Johnson said afterwards that once the studies are completed funds will be provided to "see to it that America forges ahead in the space field." But he said first Kennedy wanted present programs reviewed with a "fine-toothed comb."

Kerr struck much the same cautious theme. He said the new Administration must give current programs "close study and scrutiny." He noted pointedly that financial projections for space planning were running far ahead of actual current spending.

Underlying their statements was the feeling by a number of Kennedy Administration advisers that some U.S. space programs both current and planned are not worth their fancy pricetags—that these programs should be redirected or the money should be spent elsewhere.

U.S. may be year behind Reds . . .

Mariner Carries Planet Fly-by Hopes

First details guidance planned for shot past Venus; infrared scanner is key to locating planet from figure 100,000 miles out.

by William Beller and Richard van Osten

AMERICA MAY BE a full year behind Russia in making the first attempt to explore the planets.

Present U.S. timetable of space exploration now calls for a fly-by of Venus sometime during the third quarter of 1962—18 months from now. However, Venus will be in a favorable position for a fly-by starting this July —and it is possible a Soviet attempt could come then.

Leadtimes in the development of the *Mariner* spacecraft and *Centaur* vehicle are forcing into next year at the earliest the U.S. Venus fly-by, a shot designed to give a close-up instrumented "look" at the cloud-wreathed planet.

Officials of NASA's Jet Propulsion Laboratory, which is in charge of the *Mariner* program, will depend heavily on a series of earlier *Ranger* shots for launch experience and system development. There also will be some *Mariner* shots before Venus becomes a target.

One of the major questions in the fly-by program is money. It is not yet known if one or more complete backup vehicles will be available for launching during the month that Venus is in optimum position in 1962. Should only one be available—and that fails—another 18 months would pass before the planet would be in the proper position.

Nor is this all.

Even if the launch goes well, it will be a ticklish technical feat to properly orient the 50-75 lb. payload in the 1000-lb. *Mariner* so that it will find the planet. The key instrument in locating Venus from 100,000 miles out will be an IR scanner.

• **Assignments**—The system will then lock on and track. A horizontal platform containing the instrumentation package will be pointed at the center of Venus. Exploration from this distance will include:

–Spectroscopy in ultraviolet and visible spectrum.

–Field and particle measurements.

Best Years for Launching Flights to Venus and Mars

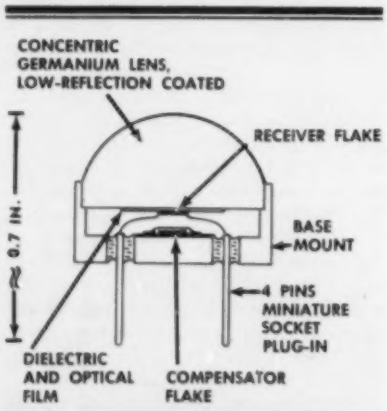
1961	VENUS	
1962	VENUS	MARS
1963		
1964	VENUS	MARS
1965	VENUS	
1966		MARS
1967	VENUS	
1968		MARS
1969	VENUS	
1970	VENUS	

–Cosmic ray and dust measurements.

–General radiation measurements of the planet in millimeter and centimeter wavelengths.

Proportional telescopes may be used to aid in determining the location of *Mariner* at the time of data transmissions back to earth.

Position of the spacecraft in relation to Venus, the sun and earth, moreover, will be critical for data integrity and transmission. This means the system must keep the spacecrafts solar cells (capable of delivering 300 watts raw power) pointed at the sun while highly directional antennas are pointing at the earth.



DETAILS: immersed thermistor bolometer.

The orientation system is being developed for JPL by Barnes Engineering Co., of Stanford, Conn.

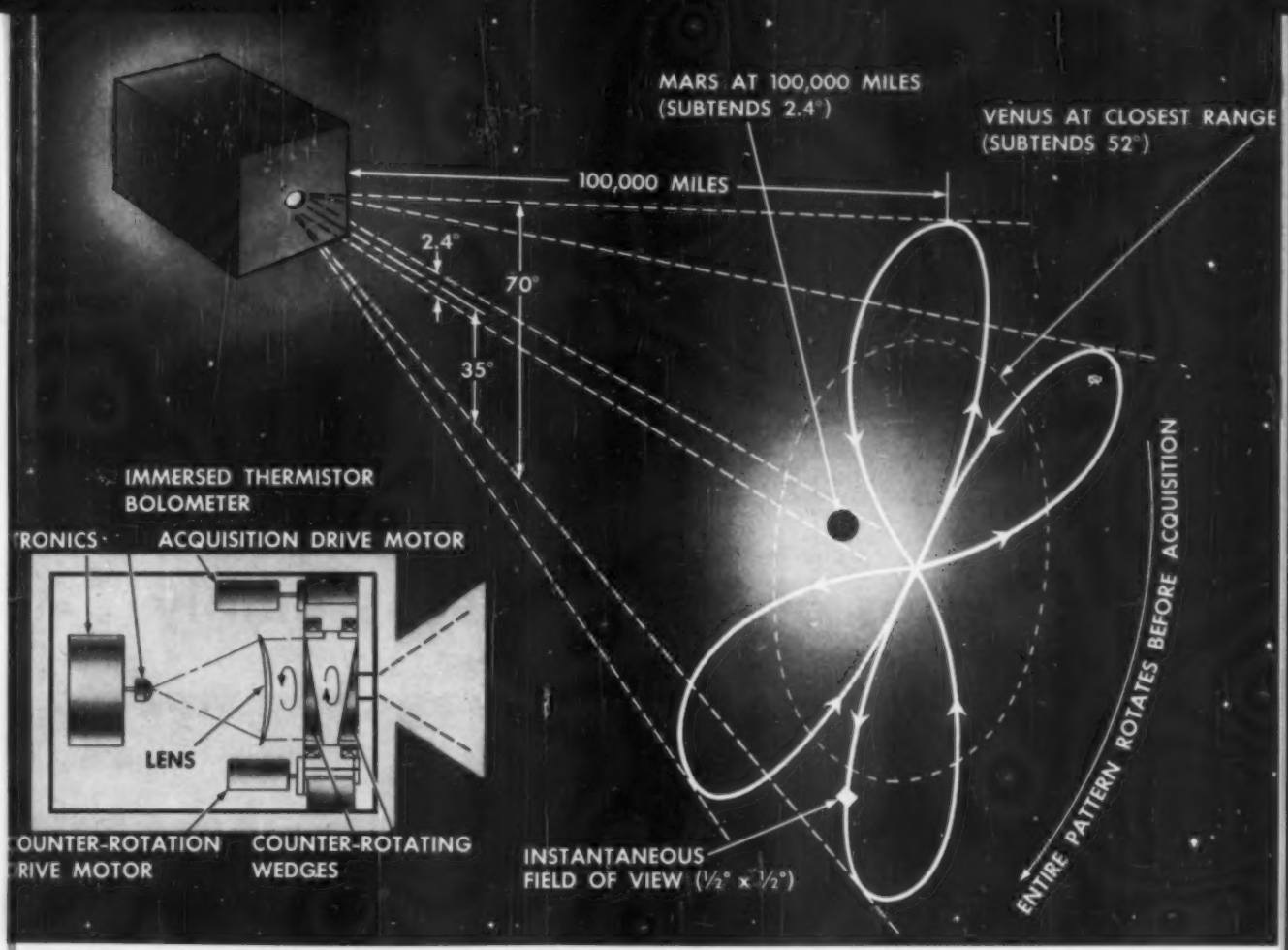
At the present time, the *Mariner* program comprises seven interplanetary missions, all Venus and Mars fly-bys. The first launching of a prototype of the Mars spacecraft is scheduled for 1963. This will be a development mission and a prelude to a 1964 Mars fly-by.

Toward the end of the present decade, the *Mariners* will give way to *Voyagers* which will be using *Saturn* C-1 and C-2 launch vehicles. These will be able to carry more than 20,000 pounds payload and will be used for planetary orbiters and orbiter-landers.

In the *Mariner* probes, the sensors must have high sensitivity because only small amounts of IR radiations will be coming from the target planets. The IR from Venus will emanate from the top of its dense atmosphere, which is at a temperature of 154°F. The IR from nearly airless Mars will be coming from its surface, which is at 45°F at the equator, –90°F at the poles.

Because of the low temperatures of the emitting surfaces, the IR available for navigation will be at the long wavelengths. However, most detectors sensitive to these wavelengths require cooling by bulky liquid gas systems and therefore are not suited for a compact space vehicle installation, says Banres' vp and technical director Eric M. Wormser. He claims that this is the reason that thermistor bolometer detectors, which are sensitive to long wavelengths without the need for cooling, were selected for *Mariner* missions.

• **How to find a planet**—At about 100,000 miles from either Venus or Mars, the IR sensor is ready to take control of the probe. Its first task is to find the planet. To do this, the sensor uses a pair of counter-rotating wedges, one turning at about 300 rpm, the other at about 100 rpm. These "see" an instantaneous field of view of ½° by ½° whose locus is a rosette-shaped



SCHA OF INFRARED SYSTEM to be used to orient Venus/Mars fly-bys to keep their instruments facing the planets.

pattern 70° in diameter.

For the probe to be effective, previous guidance and attitude control must have oriented the spacecraft so that the target planet falls within the 70° field of view of the IR sensor system.

While the rosette is being generated, the pattern is being rotated about 5 rpm until the target is found. Then the acquisition motor stops. At the same time, the IR radiations picked up begin generating electrical voltages in the detector. By measuring the duration and timing of these voltages, the system develops error signals corresponding to each leaf in the rosette. When these errors are made equal to each other—by suitable orientation of the probe—the target is at the rosette's center.

• **Inside the bolometer**—The heart of the system is the thermistor bolometer. It is well known that thermistors are thermally sensitive resistors which show large changes in resistance with changes in temperature. Therefore, the devices can be used as IR radiation detectors. When they are, they are made in small and very thin flakes. For fast response to changes in radiation, the flakes are solidly backed by heat sinks of high thermal conductivity.

In Barnes thermistor bolometers, closely-matched pairs of these flakes are mounted in small cylindrical capsules. The "active" or receiver flake, which is to be exposed to the IR, is centrally and precisely located with respect to the capsule's outer diameter. The "compensating" flake is located off-center and is shielded from IR.

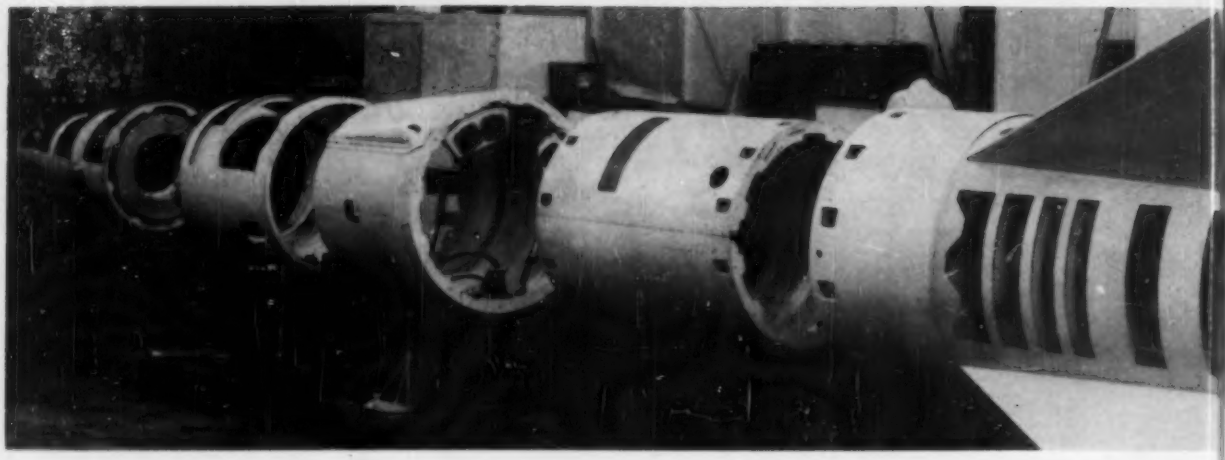
The bolometer is usually operated in a bridge circuit, with the two flakes equally and oppositely biased. The output terminal, which is the junction of the two flakes, is thus maintained near ground potential to reduce noise and microphonics. Since the two flakes are closely matched, the drift of the output terminal with changes in ambient temperature is made negligible.

When the bolometer is exposed to IR, the active flake is heated, its tem-

(Continued on page 40)

Properties of Mars and Venus Relevant to Their Infrared Detection

PROPERTY	MARS	VENUS
DIST. FROM SUN (EARTH = 1)	1.524	0.723
TEMP. (°K)	280 (equator) 205 (pole)	430 (surf.) 225 (top of atmos.)
TOTAL RADIANT ENERGY EMITTED (watts/cm²-steradian)	0.011 (equator) 0.0032 (pole)	0.063 (surf.) 0.0046 (top of atmos.)
PEAK WAVE LENGTH OF RADIANT ENERGY EMITTED (microns)	10 (equator) 14 (pole)	7 (surf.) 11.5 (top of atmos.)



First Photos of Nike-Zeus Assembly

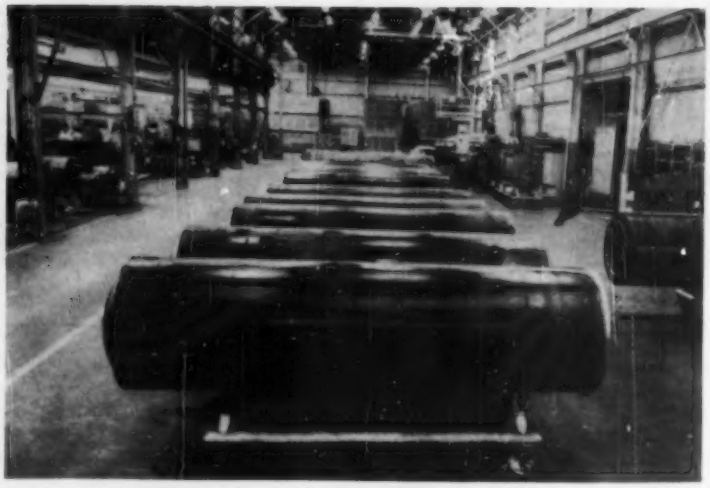
ARMY's *Nike-Zeus* anti-missile missile takes shape at White Sands Missile Range, N.M., prior to a recent R&D test firing.

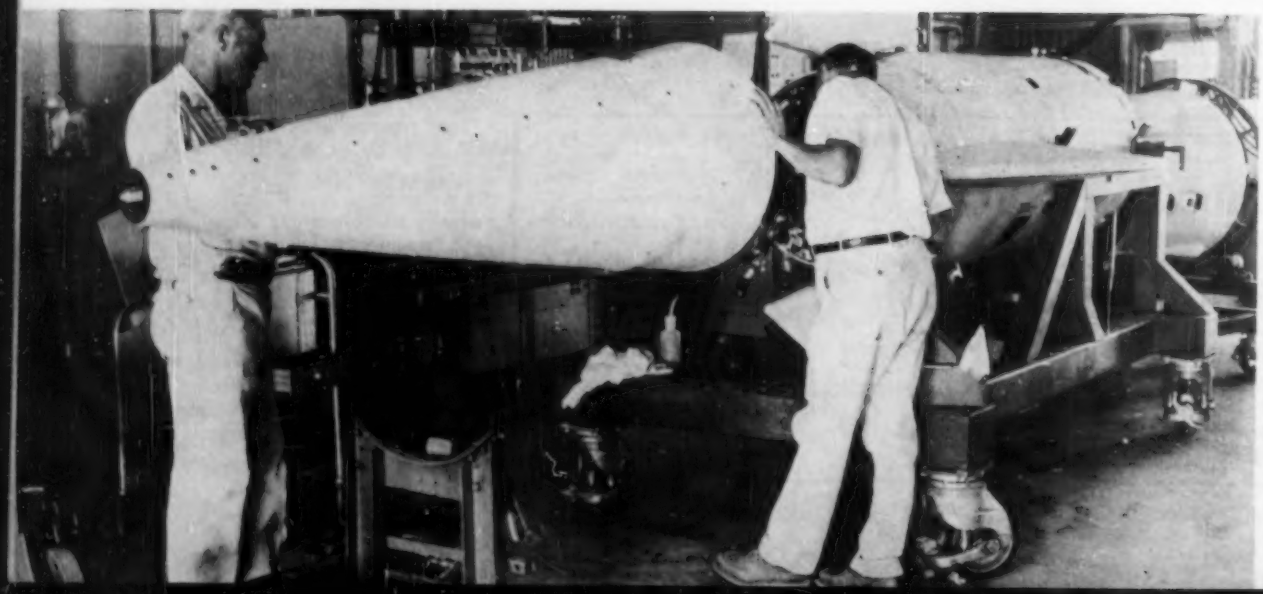
Photo above shows a mockup of the warhead and sustainer sections of the bird, a product of a combined Army-Industry team with Western Electric Corp. the prime contractor and Douglas Aircraft Co. the subcontractor and responsible for motor cases.

At right, booster and sustainer motor cases await assembly.

Below, technicians in the Missile Assembly Building join component parts of the *Nike-Zeus*. Each section of the Free World's only anti-ICBM weapon is handled separately and joined just before firing.

The newest and largest of the Western Electric *Nike* family has been undergoing intensive developmental firings at White Sands and has completed its first successful guided flight. It will soon be tested against ICBM's over Pacific Missile Range.





Atlas-based Shot Failures Worry NASA Planners

CAPE CANAVERAL—Reliability of *Atlas*-based launch vehicles is causing great concern among officials of the National Aeronautics and Space Administration.

A measure of the magnitude of the situation is given by the fact that NASA plans to launch at least 35 *Atlas*-based vehicles in the next three years, a program whose cost will approach a half-billion dollars.

But even more than money is at stake. America's astronauts are scheduled to make their orbital flights with the aid of *Atlas* launchers.

So far, NASA's record with *Atlas*-based vehicles is 0 for 6. Four of the six were used in the now-defunct *Atlas-Able* moon orbit program and two were tests for Project *Mercury*.

The Air Force's record with *Atlas*-based space probes is little better—1 for 3.

• **Cost of complexity**—No one is pointing the finger at *Atlas* alone, which has a record of 47 successes, 11 partial successes and 16 failures in 74 military test launchings. The question raised in some quarters, rather, is whether putting upper stages or complex payloads on the already complex *Atlas* system increases the intricacy to such a degree that reliability is almost impossible.

At a briefing following the explosion of the *Atlas-Able* lunar probe vehicle after 70 seconds of powered flight Dec. 15, spokesmen for NASA, Space Technology Laboratories and the AF Ballistic Missile Division affirmed their faith in the design of the 3½-stage vehicle.

Lawrence I. Hogarth of NASA's Goddard Space Flight Center, Adolf Thiel of STL and Maj. Edward Darcy of BMD voiced disappointment that none of the four vehicles in the program succeeded in putting the 388-lb. spacecraft into an escape trajectory so as to test the technique for injecting it into an orbit about the moon.

Hogarth said that, so far as he knew then, there was no intention to fire another similar shot. It would take from 9 to 12 months to do so if such a decision were made, he added.

The lead time required for another vehicle means that it could not be available before NASA begins testing the *Ranger* aboard *Atlas Agena B* launch vehicles. But Hogarth said there were no present plans for putting the *Atlas-Able* spacecraft's hydrazine engine and mid-course and terminal guidance gear aboard *Atlas-Agena B* launch vehicles.

Following the Dec. 15 explosion, NASA began a lengthy investigation into the cause, saying only, "it appears that a malfunction occurred in the launch vehicle." ¤

The Missile/Space Week

Mercury Cost Expected to Hit $500 Million

The House Space Committee Staff is forecasting that the pricetag for NASA's Project *Mercury* may well exceed a half-billion dollars before the program ends. That would put the cost of *Mercury* at about 150% more than originally estimated when the program was initiated in 1958.

The committee staff said in a preliminary *Mercury* progress report that it based the possible half-billion dollar cost on the expectation that *Mercury* would not hold to its much readjusted schedule. The staff said the program would cost $393 million if it meets all of its present flight test target dates.

Despite the rising cost of the program, the staff report said *Mercury* is "progressing satisfactorily." As for statements by critics that *Mercury* is being overtaken by advancing technology, the report said there is "no categorical indication that such is the case."

The Pentagon Lineup Takes Shape

An old Pentagon hand and a politically savvy attorney will be taking over direction of the Air Force and Navy respectively this month.

President-elect Kennedy this last week added to his principal Pentagon nominations:

–Eugene Zuckert, a 49-year-old Washington lawyer, as Secretary of the Air Force. He formerly was an Assistant Air Force Secretary during the Truman Administration and a member of the AEC.

–John B. Connally, a 43-year-old Ft. Worth lawyer, and ex-Naval officer as Secretary of the Navy. He formerly was Vice President-elect Lyndon Johnson's administrative assistant and served as Johnson's campaign manager during the drive to make him the presidential nominee last year.

Zuckert is considered an experienced government official who knows his way around Washington. Connally is considered to be sharp-minded and a political fighter.

Air Force Missile Defense Work Grows

Expanding Air Force activity in the missile defense field received another boost this last week with a $147,803 contract to Douglas Aircraft.

The contract—let under an ARPA project delegated to the Air Force—is for a three-month study of the exhaust heat trails of missiles launched from Cape Canaveral. Aerojet-General is a subcontractor for the project.

The study will be made with electronic monitoring equipment carried aboard an Air Force B-50. The operational ceiling of a B-50 is about 35,000 to 40,000 feet.

Army Drone Cancellation Consolidates Programs

The Army is consolidating its surveillance drone programs with the sudden cancellation of its contract with Republic Aviation for development of the *SD-4* combat surveillance drone. Components of the *SD-4* system such as airborne guidance units and radar equipment will be used in other Army surveillance projects.

However, the cancellation clearly indicated that the economy squeeze rather than consolidation was the principal reason for the move. The Army had spent $34 million on the project so far. The first *SD-4* flight was scheduled for next month. The program represented about one percent of Republic's backlog.

New Soviet Missiles Cover Red China

The Russians are reported to be building a new chain of Asian bases for 3000-mile range missiles. (M/R, Feb. 15, 1960.)

The bases—reported by the Italian News Agency Continental—to be under construction on the Kamchatka Peninsula—could be used for peppering missiles on Red China, Japan and Alaska.

The news agency also reported that the Russians have completed 22 missile bases on the Kola Peninsula near the Finnish border and have under construction another group around Lake Baikal near the Mongolian border.

Weather Satellite System Weighed

New Administration will decide whether to invest in Tiros-type or wait until '63 for improved Nimbus

A PLAN FOR an operational weather satellite system, to be set up in addition to the *Tiros-Nimbus-Aeros* series of research satellites, is being prepared for submission to the Kennedy administration.

The National Aeronautics and Space Administration, the Weather Bureau, the Department of Defense and possibly the Federal Aviation Agency plan to begin discussions soon on the system, which presumably would be operated by the Weather Bureau.

The major question to be decided by the joint committee is whether to go ahead now with *Tiros*-type satellites or to wait for *Nimbus*, which probably will not be available for operational use before 1963.

Dr. Morris Tepper, NASA chief of meteorological satellites, has prepared a 45-page memo outlining problems that will have to be settled before any decision is made to go ahead with an operational program.

The decision to begin an interagency study of the problems was made at a high-level meeting in October. The work apparently was speeded after the successful launching of *Tiros II*. Top agency officials agreed Nov. 26, two days after the launching, that the Weather Bureau would control operational use of weather satellite data.

Tepper emphasized in an interview that the number of problems to be solved made it impossible to predict how long the study would take. He declined even to predict whether committee recommendations would be ready for submission to Congress during its 1961 session.

• **Range of problems**—The NASA meteorologist said problems fall in five major areas—requirements, elements of the system, operational factors, scheduling and management.

Under requirements, the major question is whether the user agencies—the Weather Bureau and military weather services—will be satisfied with the performance possible in the spinning *Tiros* satellites. *Tiros* pictures must be "rectified" by a complex process because they are taken at an oblique angle, rather than from a vertical position (M/R, Dec. 5, p. 15). The *Nimbus* satellite, which will begin flight tests late in 1962, will be stabilized so that its lenses and instrumentation point permanently toward the earth.

Once the requirements are established, the need is to set up a system—the satellites in flight, launch vehicles, facilities for receiving and converting data and communications links to weather information channels.

Operational factors cover the questions of how elements of the system fit together.

Scheduling covers availability of vehicles, spacecraft and pad and range time.

Finally, under management, are the questions of who runs what. All that is decided to date is that a civilian user agency—either the Weather Bureau or a special weather satellite agency—will have charge of use of the data. Who will have charge of design of spacecraft and launchings is up in the air.

• **Add one Tiros**—Regardless of what kind of operational satellite program is chosen, Tepper said, NASA will pursue a vigorous R&D program. For the immediate future, NASA is considering the possibility of adding one *Tiros* to the 1961 schedule.

A spacecraft launch vehicle, which had been tentatively scheduled for January as a backup for *Tiros II*, could be used for the purpose. Tepper said the most likely possibility is a *Tiros* launch during the spring, to obtain data on spring storms, and the fourth *Tiros* as previously scheduled later in the year.

• **Outlook for Nimbus**—The first *Nimbus* will be launched some time in 1962, Tepper said. Apparently, his statement represented some slippage from the previous target of the second quarter of that year.

NASA's Goddard Space Flight Center held an industry briefing Nov. 28 on the prime contract for the spacecraft. Bids were due Dec. 28 and Tepper said he hopes to award a contract before March 1. The contract will call for delivery of a prototype and three flight model satellites, which will cover the first two launches.

Later, there will be two flights of an advanced *Nimbus* with more sophisticated instrumentation. All *Nimbuses* will be launched down the Pacific Missile Range into 80° retrograde orbits.

The first two will carry improved television cameras for daytime cloud observation, infrared sensors to make nighttime observations and measuring total heat balance, and solar observations of importance to meteorology.

Nimbus 3 and 4 may carry radar and infrared spectrometers. A third possibility is some sort of device for on-board analysis of satellite observations, to help reduce the flood of data sent to ground stations. ⌗

Report Urges Studies of Space Impact

EXHAUSTIVE investigation of the impact of space activities on mankind is recommended in a Brookings Institution report to the National Aeronautics and Space Administration.

Working under a $96,000 NASA grant, the Brookings group suggested in a 190-page report that NASA establish an in-house staff of social scientists to supervise studies contracted with outside groups of the implications of such subjects as weather satellites, communications satellites and the impact of operations in space on industry, government organization, foreign policy and the availability of scientific and technical manpower.

Donald N. Michael, who headed the eight-man Brookings group, said the study was authorized by NASA under the provision of the 1958 Space Act requiring the government to establish "long-range studies of the potential benefits to be gained from the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes." The study was merely to point out problem areas, not solutions. The Brookings group produced 190 pages of problems.

Although the report recommended that the studies be carried out by NASA, Michael said, they might just as well be performed by another agency of the government.

The Brookings report was issued a week before President-elect Kennedy announced that Vice President-elect Johnson will head the National Aeronautics and Space Council, a top-level

(Continued on page 40)

space medicine

How to Make Man Efficient in Space?

ARTIST'S CONCEPTION of a re-entry configuration which the Martin Co. has been studying. The shape may figure in the design of Apollo or Slomar.

by Heather M. David

THE BIGGEST PROBLEM in manned spaceflight in the 1965-75 era may not be keeping man alive but keeping him functioning at peak efficiency.

Dr. M. A. Grodsky, head of the Life Sciences section of The Martin Co.'s advance systems and advance systems research department, said that Martin was not particularly worried about the life support aspects of future space travel.

"I am fully confident that by 1965 many of the physiological problems will be understood and the necessary equipment can be built. We are concerned about maintaining the space traveler's high performance."

Martin has launched a battery of studies along several different lines from which it hopes to learn how to get optimum human performance. Two of the current contracts to which these studies will be applied are *Apollo* and *Slomar*.

Under the six-month *Apollo* study contract awarded to Martin by the National Aeronautics and Space Administration, the company is to investigate the feasibility of a three-man spaceship capable of circumlunar missions lasting about 14 days. Convair and General Electric MSVD received like contracts.

Besides the basic propulsion, navigation and re-entry problems, Martin is putting emphasis on the relationship between man and machine and man to man. Some 15 researchers with degrees in psychology, mathematics, physiology, biochemistry, engineering and neurology daily attack problems which will face man in the 1965-1975 period. "There will be no time for errors when we get into space," is the general theory.

• **Vehicle control**—The preliminary concept of *Apollo* is that the ship will be compartmentalized into three sections. The command center will be used by the pressure-suited and strapped down astronauts during launch and re-entry. The propulsion center would be used in case of an aborted mission for return to earth.

The crew work area, in which most of the trip will be spent, is the main concern of the Life Sciences group.

The Martin Co. has constructed a full-size mockup of a crew work center in which it will run extensive tests to develop the best methods of presenting information. With it the researchers will try to discover what kind of information is most useful to the crew and causes no confusion.

Another problem the group is attacking is how accurate or clear this information must be.

With a simple projector type machine which flashes geometric shapes at different degrees of resolution, the Life Sciences group has found that humans can perceive what they need to know at resolutions far lower than previously thought. This research they hope, may lead to savings in cost and power.

Four full-time "subjects" are employed by the Life Sciences group to do nothing but take perception and "vigilance" tests all day. Members of the Martin staff, including pilots and engineers, are available to the group for testing which requires more trained subjects.

• **Length of work periods**—Dr. Grodsky's group has been doing considerable research in the area of vigilance, or ability of the subject to perform effectively over long periods of time.

Many studies have indicated that man's ability to make correct decisions slips more and more the longer he is tested. It appears from these tests that he could not perform effectively for a very long time.

The Martin group is delving into the problem a little further with the idea that perhaps the subjects were not tiring, but changing their criteria for making decisions—getting more lax as time wore on. The data the Baltimore group is coming up with indicates that humans can be trained to work long periods of time and still give good performance.

• **Psychological sensors**—Isolation and confinement on trips such as *Apollo* will not be the problems many think they will, according to Martin's conception. There will be enough real tasks in space to keep the astronauts well and busy.

It will probably be necessary to have some artificial task to monitor pilots' psychological condition. There are hundreds of possible tests, says Dr. Grodsky, but the question is finding the right one or ones.

Tests on animals are worthless on humans. And in addition, the researchers would like to be able to predict what the man's condition will be a given time after the test.

• **Radiation**—The advanced systems group is also planning a study on the amount of permissible radiation for man. Martin's group hopes to show that, with some risk, space travelers may be able to tolerate far greater exposure than previously estimated.

The group is basing its study on clinical data being collected by Dr. W. Loomy of Johns Hopkins and on data released from Japan.

Next step in this study will be to start animal studies. The animals used in the radiation experiments will also be subjects for disorientation studies. Later in the year the Life Sciences department expects to get a surgical laboratory where it will experiment with labyrinthectomized animals, or animals with their inner ears surgically removed.

• **Food acceptability**—Nutrition almost has become a problem for the psychologist in planning for space travel. The Life Sciences section plans to do some very complete studies on the relatively acceptable levels of different foods, from algae on up. ⌗

Chimp to Go in Next Flight Test Of Mercury

Given all possible breaks, U.S. might be able to get an astronaut into space in early March

by Jay Holmes

CAPE CANAVERAL—A chimpanzee will ride in the next *Mercury Redstone* ballistic flight, probably late this month. This would put the shot some 15 months later than originally planned.

The test, designated MR-2, will be the first flight test of the man-in-space capsule's life support system. If the shot succeeds, the next *Mercury Redstone* (MR-3), will carry an astronaut.

The timing of the MR-3 flight—on a 4200 mph ballistic trajectory that will mark America's first manned space flight—is subject to all of the variables possible in a research and development program. With a streak of perfect luck in the next 60 days, Project *Mercury* might be able to fly a man by early March. A more realistic date, however, is mid-April.

If America beats Russia in the launching and safe return of a man from ballistic flight in space at 125 miles altitude, one result would of course be an important psychological victory. But it would be only a step, although an important one, toward accomplishing the prime objective of Project *Mercury*, manned orbital flight.

U.S. officials still say they expect to orbit a man in 1961, but most dispassionate observers agree that the orbital shot seems bound to slip into 1962. Thus Russia, despite the recent failure of her prototype space ship to return from orbit, still is the odds-on favorite to put a man or men in orbit first.

• **Light dimly seen**—Nevertheless, managers of the trouble-plagued man-in-space program are beginning to voice cautious optimism that at least one phase of their troubles is behind them.

"All of our missile programs had troubles at the start," said Walter C. Williams, chunky chief of operations for the National Aeronautics and Space Administration project. He referred obviously to the months of slippage that preceded the first successful launch of a capsule by a *Redstone* on Dec. 19 and to the continuing delay following the disastrous first *Mercury Atlas* shot last July.

"We have had our share of problems," Williams told MISSILES AND ROCKETS. "But now we have capsules coming out of McDonnell at a pretty good rate. We are getting repeatability. The next job we have is to learn to fly them well."

Besides MR-1, which was returned to the McDonnell plant at St. Louis for thorough examination, four production capsules have been at the Cape for at least three weeks. They are: Capsule 5, assigned to MR-2; Capsule 6, assigned to MA-2; Capsule 7, assigned to MR-3, the first manned flight, and Capsule 8, assigned to MA-3.

• **Flight record**—Four production versions of the capsule now have flown. Capsule 1 flew in a test of the escape tower at Wallops Island, Va., last May 9. Capsule 4 was carried on the MA-1 test in which the *Atlas* exploded July 29. Capsule 3 flew in the *Little Joe* test at Wallops Island Nov. 8.

Capsule 2 flew on the Dec. 21 MR-1 flight, which *Mercury* director Robert R. Gilruth described as an "unqualified success." It reached an altitude of 135 statute miles and traveled 235 miles downrange.

After the 11:15 a. m. launch, events followed this staccato timetable: Landing at sea, 11:31 a. m.; recovery by a Marine helicopter, 11:46 a. m.; delivery to the carrier Valley Forge deck, 12:03 p. m.

The only apparent damage was a slight searing of the paint on the hull and a broken window pane on one port. Each window has three or four panes. Thus the breaking of one port on impact would not have created any problem if an astronaut had been inside.

• **Blinker inadequate**—When the capsule was flown to the Cape, about 20 hours after launch, internal batteries were still powering equipment aboard, including a clock inside and a blinking white light at the top of the bell, de-

ABOARD USS Valley Forge the MR-1 Project Mercury spacecraft is washed down and prepared for return to Cape Canaveral after Dec. 19 launching.

signed to aid in recovery operations.

One change indicated by the test is a bigger blinker. Lt. Wayne Koons, pilot of the helicopter, said he and his crew did not see the light against the glare of the bright noonday sun reflected from the sea. The Marines spotted the capsule with the aid of smoke.

• **Booster change**—MR-1 succeeded on its third attempt. The shot was scrubbed Nov. 7 when a valve in the capsule's reaction control peroxide jet system was found to be not functioning properly 22 minutes before launch time. Two weeks later, the booster ignited, burned for a few milliseconds and shut down. The cutoff signal then actuated the escape rocket jettison tower and carried it away just as should have happened on a shutdown at 35 miles altitude, at the conclusion of normal burning. Then the capsule's parachutes were deployed, also as programed, when their controls sense thick atmosphere after jettisoning of the escape tower.

The premature engine cutoff was traced to a plug that grounds the booster electrically, which had disengaged a fraction of a second too soon. The problem was solved by making the ground connection cable several inches longer to make certain it disengages last in sequence with other pad-to-booster connections.

The booster used in the Nov. 21 attempt lifted an inch or so from the pad and then settled back, damaging the tail section slightly. As a result, a new booster was used. No. 2 capsule was used again, however, refitted with an escape tower and parachutes.

Williams noted that the booster and capsule "saw each other" for less than two weeks before the successful flight.

One other change in the MR-1 system grew out of the Nov. 21 experience. A timer device was interposed between the engine and the escape tower jettison rockets to prevent an engine cutoff signal getting through to the tower until the booster neared the end of its normal burning time. The circuitry, however, is set up so that a command from the ground will fire the escape rockets and pull the capsule free of the booster in case of booster malfunction.

• **Willing astronaut**—Williams, who sits in the operation control "slot" on all *Mercury* launches, said high winds at 60 miles altitude caused the capsule to travel 15 miles farther downrange than the 220 miles programed. He added that the deviation was within tolerances.

The reaction jets worked well in positioning the capsule for re-entry, Williams said, and the maximum deceleration was 10 g, instead of the expected 11 g.

Navy Lt. M. Scott Carpenter, the astronaut assigned to the communication console during the test, said he did not observe any situation that would have required him to assume control, had he been aboard. He replied in the affirmative when asked whether he would have liked to be aboard.

The capsule fittings, however, did not include the life support system and an astronaut's couch. In their place were a 16-mm camera, installed to the left of where the pilot's head would be, recording the functions of the cockpit instrument display panel, as well as extra instrument boxes and ballast weights.

• **Teams of apes**—Eight animals are in "training" at Holloman AFB, N.M., for the chimpanzee mission. The simians, averaging 60 lbs. in weight and 50 in. tall, have been separated into groups of four to prevent spread of any disease they might develop.

Both groups have spent some time at Cape Canaveral for training in an altitude simulator fitted with the production version of the capsule environmental control system. They have been returned to Holloman but all will move to the Cape again for selection for the flight.

• **Severe test conditions**—The next *Mercury Atlas* shot, Williams said, will be largely a repeat of MA-1, to qualify the capsule by putting it to a mission abort during powered *Atlas* flight. The suborbital ballistic profile of the flight calls for a re-entry that will subject the capsule afterbody to extremely high temperatures and high air-load conditions—far more severe than those the capsule would encounter after a normal orbital flight.

The program calls for boosting the capsule to an altitude of 110 miles and a speed of about 13,000 statute mph, and landing it 1500 miles downrange about 20 minutes after launch. On re-entering at 50 miles altitude, the nickel alloy afterbody shingles will heat up to about 1500°F and the blunt face of the ablation heat shield is likely to go up to 3000°F.

The capsule body, in such a re-entry, would be subjected to deceleration of up to 16 g, twice the g load encountered in re-entering after a normal orbital mission. The heavy g load is due primarily to the sharp re-entry angle programed, four to five times the normal re-entry angle of about 2°.

The operations chief declared that MA-2 will provide much more of a system test than would have been possible with MA-1, a capsule shell pulled out of the production line for an early check of the structure.

In the new test, the capsule will carry many of the internal capsule systems—not only the shell. Williams said that, if the booster performs properly, the next shot will carry out the tests programed originally for both MA-1 and MA-2.

• **Second phase**—After completion of the *Atlas* ballistic tests, the next phase of the *Atlas* program calls for firing of capsules in orbit without occupants, capsules in orbit with chimpanzees and, finally, manned orbital capsules. Williams declined to say just when the second phase would begin. However, NASA sources indicated last summer that MA-4 would be the first orbital capsule flight if the first three accomplish their objectives.

Despite the long delay between MA-1 and MA-2, Williams insisted NASA still expects to put a man into orbit by the end of 1961. Nevertheless, he noted that each successive step must depend on the success of previous steps in a complex R&D program—a situation subject to slippage at any step of the way.

• **Atlas is "it"**—Williams said he is not overly concerned with *Atlas* reliability. When *Atlas* was chosen as a launch vehicle, he declared, it was predicted that the vehicle would be highly reliable by the time it was needed for manned flight. He still believes the prediction will hold true.

But it will never be 100% reliable, the *Mercury* official added, "and there is nothing we can do about it."

"We have covered ourselves," he continued, "with the capsule escape system. Our problem boils down to providing the escape system and reaching our test objectives."

Regardless of the reason, Williams continued, "we could not redesign or rebuild the *Atlas*."

On the ill-fated MA-1 launch, he declared, "there is no question that an active escape system would have saved the capsule. It was intact when it hit the water," even though still attached to parts of the *Atlas* that exploded.

On the MA-1 test, as on last month's MR-1, the abort sensing system was on open loop. Its temperature sensing and other devices gave the signal that would have actuated the escape rockets. However, on *Little Joe* 5, launched from Wallops Island Nov. 8, the escape rockets failed to separate the capsule from the booster as programed at 35,000 ft. ■

NEW DEPARTURES IN MINIATURE

ULTRA-CLEAN INCUBATORS FOR M/I* BALL BEARINGS

N/D'S NEW WHITE ROOM PROVIDES ULTRA-CLEAN ENVIRONMENT FOR M/I BALL BEARING ASSEMBLY

N/D announces a new White Room at Sandusky, Ohio incorporating the latest technological advances available today. This new room provides a virtually dust-free atmosphere so necessary for the production of Miniature and Instrument Ball Bearings of high reliability.

Environmental controls within the room hold temperature to plus or minus 1°... with maximum relative humidity only 40%. Final air filtration into room removes particles larger than 3/10 micron. A complete air change is made every three minutes. All authorized personnel entering the room are thoroughly bathed by air showers in two successive deduster chambers.

You can benefit from New Departure's 25 years of experience in M/I ball bearing production by calling your nearby N/D Sales Engineer. Or write Department L.S., New Departure, Division of General Motors Corporation, Bristol, Conn.

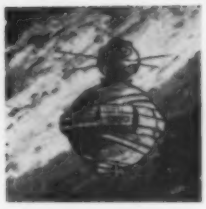
*Miniature and Instrument Ball Bearings.

SEND FOR NEW DEPARTURE'S M/I BALL BEARING CATALOG TODAY. WRITE DEPT. L. S.

NEW DEPARTURE

MINIATURE AND INSTRUMENT BALL BEARINGS

Circle No. 4 on Subscriber Service Card.



JANUARY, 1961

MISSILES and ROCKETS

ASTROLOG

Current status of U. S. missile and space programs plus all orbiting satellites

Satellites and Spacecraft

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
★**ADVENT** (Army)	Army Signal Corps, prime; GE-Bendix prime for polar-orbiting phase; Bendix prime for 24-hour satellite	Twenty-four hour instantaneous repeater communications satellite; 1000 lbs.; program incorporates Projects STEER and DECREE	R&D; ground sites to be equipped at Ft. Dix, N.J., and Camp Roberts, Calif.; shipboard terminals also being designed
★**ANNA** (Army, Navy, AF, NASA)	No contractors announced	Geodetic satellite; 50-100 lbs.; probably spherical	Study completed; R&D program appears imminent
AEROS (NASA)	No contract announced	24-hour weather satellite to be boosted by CENTAUR or SATURN	Planning. First flights would be in 1964 or 1965
APOLLO (NASA)	Convair, Martin, GE	Three-man spacecraft capable of orbiting moon or becoming space station; probably winged for lunar flights; boosted by SATURN	Six-month studies in progress; R&D prime to be chosen in FY '62
★**ARENTS** (ARPA)	Convair, prime	Satellites to investigate deep space; 22,000 n. orbits	Contract let to build three payloads
★**ASP** (Air Force)	No contracts announced	Aerospace plane, a manned spacecraft capable of operating in the atmosphere and space	Study
★**BAMBI** (ARPA)	No contracts announced	Satellite system capable of intercepting enemy satellites	Studies
COURIER (Army)	Army Signal Corps, prime; Philco, payload; Radiation, Inc., antennas; ITT, ground stations	Delayed repeater communications satellite; 51 in. diameter, 500 lbs.	COURIER 1A launching failed in August because of booster blow-up. COURIER 1B placed in orbit Oct. 4, transmitted messages and pictures
★**CSAR** (Air Force)	No contracts announced	Communications satellite system; satellites to weigh possibly two tons; to use passive lens reflectors	Studies; possibly operational mid-60's
★**DISCOVERER** (Air Force)	Lockheed, prime; GE, re-entry vehicle	THOR-AGENA and ATLAS-AGENA launchings of early stabilized satellites; main purpose is to test techniques for military space systems	Launchings: 19; capsules recovered from orbit and air snatched; after orbiting earth one to three days; simians to be put in capsules in 1961
★**DYNA-SOAR I** (Air Force)	Boeing, spacecraft and systems integrator; Martin, propulsion; Minneapolis-Honeywell, guidance; RCA, communications data link	Boost-glide orbital spacecraft; R&D leading to first space bomber; TITAN I booster; TITAN II probably to be used later	R&D; first glider flights from Edwards AFB by 1962; intensive material studies underway; R&D space flight about 1966
★**ECHO** (NASA)	Langley Research Center, prime	Puts 100 ft. inflatable sphere in 1000 mile orbit; passive communication satellite; next model more rigid	Second launching attempt successful Aug. 12; next shot this year

★ Indicates change since November, 1960 Astrolog

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
★MARINER (NASA)	JPL, prime	600-1200 lb. unmanned spacecraft for early interplanetary missions; boosted by ATLAS-AGENA B	Seven shots planned. First scheduled Venus fly-by 1962 third quarter
★MERCURY (NASA)	NASA, prime; McDonnell, capsule	First manned satellite; 1 ton capsule boosted by ATLAS	Program continues to slip. First manned capsule launching by REDSTONE now scheduled this spring. First manned orbit shot expected late 1961 or early 1962.
★MIDAS (Air Force)	Lockheed, prime	Early-warning satellite; detect ICBM launchings by infrared before birds leave pad; R&D models weigh 2 tons; operational system to have 12-15 satellites	R&D; second launching May 24 partial success; components being tested by DISCOVERER
NIMBUS (NASA)	No contracts announced beyond minor subsystems	2nd generation weather satellite; THOR-AGENA B booster	First launching scheduled for early 1962, but procurement delay makes date doubtful
OAO (NASA)	Grumman, prime; Westinghouse, electronic components	3500-lb. orbiting astronomical satellite observatory equipped with telescope; boosted by ATLAS-AGENA B	First flight scheduled in late 1963
★OGO (NASA)	Space Technology Laboratories, prime	1000-lb. satellites with instruments for geophysical measurements; polar (POGO) and eccentric (EGO) shots planned; ATLAS-AGENA B, THOR-AGENA B, CENTAUR boosters	First flight scheduled in 1963
★OSO (NASA)	Ball Brothers, prime	350 lb. orbiting solar observatory; THOR-DELTA booster	First flight planned early in 1961
PROSPECTOR (NASA)	No contract announced	Soft-landed, remote control, unmanned moon exploring spacecraft. SATURN booster	First flight planned by 1965; study contracts to be awarded in 1961
★RANGER (NASA)	JPL, prime; Aeronutronic, capsule; Hercules, retrorocket	300-lb. rough landed instrumented capsule on moon; ATLAS-AGENA B booster	R&D; first flight planned 1961; first lunar landing planned for 1962, instrumentation to include seismometer
REBOUND (NASA)	No contract announced	System of 12 or more multi-launched passive communications satellites	Study
★SAINT (Air Force)	RCA, prime	Anti-satellite satellite inspection system; to be complemented by interception system; ATLAS launched	R&D underway
★SAMOS (Air Force)	Lockheed, prime	Reconnaissance satellite; formerly SENTRY; R&D model weighs 4100 lbs.	R&D; first launch failed to put SAMOS in orbit Oct. 11; scheduled to be operational late 1962, early 1963 under new, bigger program; components being tested in DISCOVERERS
★SLOMAR (Air Force)	Lockheed and Martin, prime	Logistics, maintenance, supply spacecraft for space systems	Study contracts awarded in December
SURVEYOR (NASA)	No contract announced; STL, McDonnell, North American, Hughes competing	Soft-landing 100-300 lbs. instrumented spacecraft on moon; ATLAS-CENTAUR booster	Competing studies completed; R&D contract to be awarded early 1961; first moon flights '63-'64
★TIROS (NASA-AF-Army-Navy-Wea. Bu.)	RCA-Army Signal Corps, prime	Meteorological satellite; TV pictures of cloud cover; TIROS II carried IR scanner	R&D; first launching in April; second Nov. 23, both successful. At least one more planned
★TRANSIT (Navy)	Applied Physics Laboratory, prime	Navigational satellite; R&D model weighs more than 250 lbs.; operational model about 50-100 lbs.	TRANSIT IB R&D satellite in orbit April 13; IIA plus piggyback satellite in orbit June 22, four-satellite TRANSIT system scheduled operational 1962; TRANSIT IIIA launching failed Nov. 30 due to booster
VOYAGER (NASA)	No contract announced	Unmanned spacecraft to orbit Mars or Venus; eject capsule for re-entry; SATURN booster	Study; first flight planned by 1965
YO YO (Navy)	No contract announced	Tactical sea-launched one-pass reconnaissance satelloid	R&D
★X-15 (NASA-AF-Navy)	North American, prime; Thiokol, propulsion	Rocket plane; 4000 mph; flight at edge of space; on AF model each XLR-11 rocket engine develops 16,000 lbs. of thrust; XLR-99 engines 50,000 lbs. Three planes delivered.	Powered flights in progress; plane #1 has hit Mach 3 and more than 136,500 ft. with XLR-11 engine; plane #2 undergoing flight tests with XLR-99 engine; NASA to get soon

Missiles and Rockets

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
★**ALFA** (Navy)	Navy, prime; Avco, air frame	ASW surface-to-underwater; 500 lb. solid; conventional	Deployed on destroyer escorts
ASROC (Navy)	Minneapolis-Honeywell, prime; Sangamo Electric, Sonar; Torpedo, GE; depth charge, M-H	Surface-to-underwater; solid rocket torpedo or depth charge; nuclear or conventional, range about 8 miles; advanced ASROC (improved torpedo) under R&D	R&D; operational on Destroyers Norfolk, Adams, Dewey and Perry; plans call for deploying on 150 destroyers and cruisers
ASTOR (Navy)	Westinghouse, prime	ASW underwater to underwater rocket torpedo; nuclear	R&D
★**ATLAS** (Air Force)	Convair, prime; GE/Burroughs, Arma, guidance; Rocketdyne, propulsion; GE/Avco, re-entry vehicle	ICBM; more than 5500-to-7500 mile range; liquid; nuclear; ATLAS "E" series has inertial guidance; earlier ATLAS "D" has radio inertial	74 launchings; 47 successes, 11 partial, 16 failures; 11 bases for 13 squadrons; operational at Vandenberg and Warren; ATLAS E tests began Oct. 11; about 12 launchers operational—40 to 60 expected in 1961
★**ARM** (Air Force)	No contract announced	Anti-radar missile air to surface	Studies; plan for separate missile shelved at least temporarily
BOMARC-A (Air Force)	Boeing, prime; IBM/Westinghouse, guidance; Aerojet/Marquardt, propulsion	Ramjet surface-to-air interceptor; liquid booster; 250 m. range; Mach 2.7; nuclear	First squadron operational at McGuire AFB, N.J.
★**BOMARC-B** (Air Force)	Boeing, prime; Kearfott/Westinghouse, IBM Guidance; Thiokol/Marquardt, propulsion	Ramjet, surface-to-air; solid booster; Mach 2.7; more than 400 m. range; nuclear	B models being produced; a B test bird intercepted simulated target 345 miles away Oct. 14; R&D launchings: 18; 10 successes; 8 failures
BULLPUP (Navy-Air Force)	Martin, prime; Martin, guidance; Thiokol, Naval Propellant Plant, propulsion	Air-to-surface; 3-6 mile range; conventional 250-1000-lb. bomb; new model has pre-packaged liquid; nuclear-tipped model nearly operational; AF designation: GAM 83-A (HE warhead), GAM 83-B (nuclear)	Deployed with Atlantic and Pacific Fleets; bigger model under R&D; soon operational with Air Force units. Marines launching BULLPUP from helicopters
COBRA (Navy)	No contract announced	Anti-ship radar missile	Early R&D
COBRA (Marines)	Boelkow Entwicklungen, West Germany, prime; Daystrom, U.S. distributor	20.2-pound anti-tank missile; 1 mile range; 191 mph speed; solid propellant	Marines planning to purchase; Army considering them; already operational with West German troops
CORPORAL (Army)	Firestone, prime; Gilfillan, guidance; Ryan, propulsion	Surface-to-surface; 75-mile range; liquid; nuclear	Deployed with U.S. & NATO troops in Europe
CLAYMORE (Army)	No contract announced	Anti-personnel missile	R&D
CROW (Navy)	No contract announced	Air-to-air missile	R&D; has been flight tested
★**DAVY CROCKETT** (Army)	In-house project at Rock Island, Ill., arsenal	Surface-to-surface; solid; bazooka launched; sub-kiloton nuclear warhead; two launchers of different size for various ranges; vehicle mounted or carried by two men	R&D; operational this year; first NATO deliveries also this year
EAGLE (Navy)	Bendix, prime; Bendix, guidance; Aerojet, propulsion; Grumman, airframe	Air-to-air; 100-mile range; nuclear; for launching from relatively-slow Douglas Missileers now under development; EAGLE is 15 ft. long; wt., about 2000 lbs.; Mach 4; solid	R&D; Missileer production run reported to be 120 in next few years
★**FABMIDS** (Army)	Convair, Hughes, Martin, GE, Raytheon, Sylvania—feasibility studies	Mobile anti-missile defense system	Each of six contractors have $250,000 feasibility study contracts awarded Oct. 10; reports expected mid-'61
★**FALCON** (Air Force)	Hughes, prime; Hughes, guidance; Thiokol, propulsion	Air-to-air; 5-mile range; Mach 2; solid; conventional; GAR-11 has nuclear warhead	GAR-1 through GAR-4 operational; GAR-9 R&D; GAR-11 operational in near future
GENIE (Air Force)	Douglas, prime; Aerojet-General propulsion	Air-to-air; unguided; 1.5-mile range; nuclear	Operational
GIMLET (Navy)	No contract announced	Air-to-surface; unguided; considered highly accurate	R&D

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
HAWK (Army)	Raytheon, prime; Raytheon, guidance; Aerojet-General, propulsion	Surface-to-air; 22-mile range; solid; conventional; designed to hit low-flying planes	Operational; deployed at Panama, Okinawa; SUPER HAWK under development; Jan. 29 successfully intercepted HONEST JOHN, first known missile intercept of another
HONEST JOHN (Army)	Douglas/Emerson Electric, prime; Hercules, propulsion	Surface-to-surface; unguided; 12-mile range; nuclear	Operational; deployed in Europe
HOUND DOG (Air Force)	North American, prime; Autonetics, guidance; Pratt and Whitney, propulsion	Air-breathing air-to-surface; 500-mile range; Mach 1.7; turbojet; nuclear	Operational; to be launched from B-52G intercontinental bombers; stockpile expected to exceed 400
★**JUPITER** (Army)	Chrysler, prime; Ford Instrument, guidance; Rocketdyne, propulsion; Goodyear/CTL, re-entry vehicle	IRBM; liquid; nuclear; can be made mobile	To be deployed with Italian and Turkish troops. 31 military launchings: 24 successes; 5 partials; 2 failures. Full tactical GSE used for first time in Oct. 20 shot from Cape
LACROSSE (Army)	Martin, prime; Martin, guidance; Thiokol, propulsion	Surface-to-surface; highly mobile; 20-mile range; solid; nuclear	Operational; 4 units being trained; 3 more planned for 1960; being deployed in Europe and Far East; advanced LACROSSE R&D dropped
LAW (Army)	No contracts announced	Light antitank missile to be carried in tube	R&D under AOMC
LITTLE JOHN (Army)	Emerson Electric, prime; ABL, propulsion	Surface-to-surface; unguided; 10-mile range; solid; nuclear	Operational this year; units training with it
LOBBER (Army)	No contract announced	Surface-to-surface; cargo carrier; 10-15 mile range; also can drop napalm; LOBBER with warhead called BALLISTA	Studies
LULU (Navy)	General Mills/Naval Ordnance Lab, prime	Small nuclear depth charge air-dropped or launched by ASROC	Operational
MACE (Air Force)	Martin, prime; Goodyear/AC Spark Plug, guidance; Thiokol/Allison, propulsion	Air-breathing surface-to-surface; more than 650-mile range; turbojet & solid; nuclear; B model has more than 1200 m. range	Being deployed with U.S. troops in West Germany; now all mobile but hard-base version in R&D; first hard-site launch July 1960
MATADOR (Air Force)	Martin, prime; Thiokol/Allison, propulsion	Air-breathing surface-to-surface; 650-mile range	Being turned over to West Germans; also deployed in Far East
MAULER (Army)	Convair, prime	Surface-to-air; radar guidance; highly mobile antiaircraft and antimissile missile for field use; on tracked vehicle; 12 missiles per launcher	R&D; NATO may buy
★**MINUTEMAN** (Air Force)	Boeing, major contractor; Autonetics, guidance; Thiokol, propulsion first stage; Aerojet, propulsion second stage; Hercules, third stage; Avco, re-entry vehicle; AMF-ACF rail launcher	2nd generation ICBM; solid; fixed or mobile aboard railroad trains; nuclear; 3 stages	R&D; scheduled to be operational mid-1962 at Malmstrom AFB; launching of eight tethered birds from silos successfully completed in May; first full R&D launching from Cape scheduled imminently; tactical rail system tests completed; first 3 squadrons at Malmstrom; Ellsworth AFB, S.D., being surveyed for more
M-33 (Army)	Norris Thermader, prime	Four-inch diameter, small, short-range poison gas rockets; to be fired from 45-tube launchers	Operational
MISSILE A (Army)	ARGMA prime	Surface-to-surface; 10-20 mile range; solid	Design studies
★**NIKE-AJAX** (Army)	Western Electric, prime; Western Electric, guidance; Thiokol propulsion	Surface-to-air; 25-mile range; Mach 2.5; solid & liquid; conventional	Deployed in U.S., Europe & Far East; about 170 batteries in U.S. sixty-eight more to be phased out and replaced with NIKE-HERCULES
★**NIKE-HERCULES** (Army)	Western Electric, prime; Western Electric, guidance; Hercules & Thiokol, propulsion	Surface-to-air; 75-mile range; Mach 3+; nuclear; anti-aircraft, tactical missiles; mobile or fixed	Rapidly replacing NIKE-AJAX; well over 80 batteries deployed in U.S.; NIKE-HERCULES units on Formosa
★**NIKE-ZEUS** (Army)	Western Electric, prime; Bell Telephone, guidance; Thiokol/Grand Central, propulsion	Anti-missile; 3-stage; 200-mile range; solid; nuclear	R&D test launchings at White Sands. 12 R&D launchings; 7 successful, 3 partial, 2 failures. Complete system tests now scheduled for mid-'62
★**PERSHING** (Army)	Martin, prime; Bendix, guidance; Thiokol, propulsion	Surface-to-surface; two-stage solid; approx. 500-mile range; nuclear; transported on tracked FMC XM474 tracked vehicle; proposed PERSHING II would have 1000-mile range	R&D; to replace REDSTONE; 9 R&D launchings: 8 successes (both stages launched, guidance carried as passenger Dec. 12 for first time), 1 failure. Operational late 1961

★**POLARIS** (Navy)	Lockheed, prime; GE/MIT, guidance and fire control; Aerojet-General, propulsion; Lockheed, re-entry vehicle	Underwater and surface-to-surface; solid; 1200-mile range can hit more than 90% all targets in Russia; nuclear; POLARIS II (1500-mile range) and SUPER POLARIS (2500 mile range) under R&D	85 launchings of test vehicles; 60 successes; 21 partial; 4 failures; 13 also launched from submerged subs —all cleared surface; 9 successful flights, 4 failures. First sub with 16 missiles deployed in November
★**QUAIL** (Air Force)	McDonnell, prime; Summers Gyro, guidance; GE, propulsion; Ramo-Wooldridge, ECM equipment	ECM-carrying bomber decoy; about 200 m. range; jet powered	Deployed at SAC bases; carried by B-52
RAVEN (Navy)	No contract announced	Air-to-surface; about 500-mile range	Study
REDEYE (Army)	Convair, prime; Philco/Convair Atlantic Research, propulsion	Surface-to-air; 4-foot, 20-lb. bazooka-type; IR guidance; solid; conventional; container-launcher disposable	R&D; Marines also will use; NATO may buy
REDSTONE (Army)	Chrysler, prime; Ford Instrument, guidance; Rocketdyne, propulsion	Surface-to-surface; liquid; 200-mile range; nuclear	Deployed with U.S. troops in Europe; to be replaced by PERSHING
REGULUS I (Navy)	Chance Vought, prime and guidance; Aerojet-General, propulsion	Surface-to-surface; turbojet & solid; 500-mile range; nuclear	Deployed aboard U.S. submarines; REGULUS II used as target drone
★**SEMPER** (Marines)	No contracts announced	Believed to be an air-launched missile	R&D testing at Pt. Mugu
SERGEANT (Army)	Sperry, prime; Sperry, guidance; Thiokol, propulsion	Surface-to-surface; solid; more than 75-mile range; nuclear	In production
SHILLELAGH (Army)	Aeronutronic, prime	Surface-to-surface; lightweight; can be vehicle-mounted	Early R&D
SIDEWINDER (Navy-Air Force)	GE-Philco, prime; Philco/GE guidance; Naval Powder Plant, propulsion	Air-to-air; IR guidance; more than 2 m. range; conventional; new I-C models to have switchable IR and radar-guided warheads	Deployed with Navy and Air Force; all-weather type under development
★**SKY BOLT** (Air Force)	Douglas, prime; Nortronics, guidance; Aerojet, propulsion; GE, re-entry vehicle	ALBM; more than 1000-mile range; solid; nuclear; to be launched from B-52, B-70 and Vulcan bombers	R&D; to be purchased by British; operational 1964-65; test-launching to be from Eglin AFB, Fla. Program spending being cut back
SLAM (Air Force)	No contract announced	Surface-to-surface; low-altitude; supersonic; nuclear ramjet and warhead	Study-R&D
SNARK (Air Force)	Norair, prime; Northrop, guidance; ABL, propulsion	Surface-to-surface; 5500-mile range; solid and turbojet; Mach .9; nuclear	One squadron of about 20 missiles at Presque Isle, Maine
SPARROW III (Navy)	Raytheon, prime; Raytheon, guidance; Aerojet-General, Thiokol, propulsion	Air-to-air; 5-8 mile range; Mach 2.5-3; solid and pre-packaged liquid; conventional	Operational with carrier aircraft; earlier SPARROW I obsolete; new contract extending range, altitude
SUBROC (Navy)	Goodyear, prime; Kearfott, guidance; Thiokol, propulsion	Underwater or surface-to-underwater; 25-30 mile range; solid; nuclear	Estimated operational date: 1961. To be installed first on Thresher nuclear-powered attack submarine
★**SS-10** (Army)	Nord Aviation, prime; GE, U.S. licensee	Surface-to-surface; primarily anti-tank; 1600-yards range; 33 lbs. solid; wire guided; conventional	Operational with U.S., French and other NATO and Western units; battle-tested in North Africa
★**SS-11** (Army)	Nord Aviation, prime; G.E., U.S. licensee	Surface-to-surface; also helicopter-to-surface; 3800-yard range; 63 lbs.; wire guided; conventional	Operational. Under evaluation by Army; decision on procurement due for some time
TALOS (Navy)	Bendix, prime; Bendix/Sperry, guidance; Naval Propellant Plant, propulsion	Surface-to-surface; 65-mile range; solid & ramjet; Mach 2.5; nuclear	Operational aboard cruiser Galveston
TARTAR (Navy)	Convair, prime; Raytheon, guidance; Aerojet-General, propulsion	Surface-to-air; 10-mile range; Mach 2; 15 feet long & 1 foot in diameter; solid dual-thrust motor; conventional	Operational on Missile Destroyer Adams in Oct.
TERNE (Navy)	Kongsberg Vapenfabrikk, prime; Arma, systems integration	Surface-to-underwater ASW missile; 264 lbs.; HE warhead	Navy buying from Norway to equip two destroyer escorts
TERRIER (Navy)	Convair, prime; Reeves/FTL, Sperry, guidance; ABL, propulsion	Surface-to-air; 10-mile range; Mach 2.5; 27 feet long; solid; conventional	Operational with fleet
TERRIER-ADVANCED (Navy)	Convair, prime; Reeves/FTL, Sperry, guidance; ABL, propulsion	About 100% performance improvement over TERRIER	Operational Advanced TERRIERS to be deployed this year
★**THOR** (Air Force)	Douglas, prime; AC Spark Plug, guidance; Rocketdyne, propulsion; GE, re-entry vehicle	Surface-to-surface IRBM; 1500-mile range; liquid; nuclear	Operational; 4 bases set up in England. 65 military launchings: 44 successes; 11 partial; 10 failures; 42 scientific launchings: 34 successful, 2 partial; 6 failures
★**TITAN** (Air Force)	Martin, prime; Bell/Sperry, TITAN I guidance; AC Spark Plug, TITAN II guidance; Aerojet-General, propulsion; Avco, TITAN I re-entry vehicle; GE, TITAN II re-entry vehicle	Surface-to-surface ICBM; 5500-mile range; liquid; 90 feet long; nuclear; TITAN I burns LOX-Kerosene; TITAN II has storable propellants, inertial guidance, bigger payload, greater range	25 launchings test vehicles: 17 successes; 3 partial; 5 failures. 9 sites for 14 squadrons named; TITAN I operational mid-1961; first Vandenberg launchings from silo delayed by blow-up during fueling; TITAN II scheduled operational early 1963

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
TYPHON (Navy)	Westinghouse, prime; Bendix propulsion	Medium and long range seagoing anti-missile missiles; formerly called SUPER TARTAR and SUPER TALOS; solid booster and ramjet sustainer; conventional; supersonic	Early R&D; may be used on hydrofoil destroyers
WAGTAIL (Air Force)	Minneapolis-Honeywell, prime	Air-to-ground; low-level; solid; designed to climb over hills and trees	R&D
WILLOW (Army)	Chrysler, prime	Highly-classified missile	R&D
ZUNI (Navy)	Naval Ordnance Test Station, prime; Hunter-Douglas, propulsion	Air-to-air, air-to-surface; solid; unguided; 5-m. range; conventional	Operational

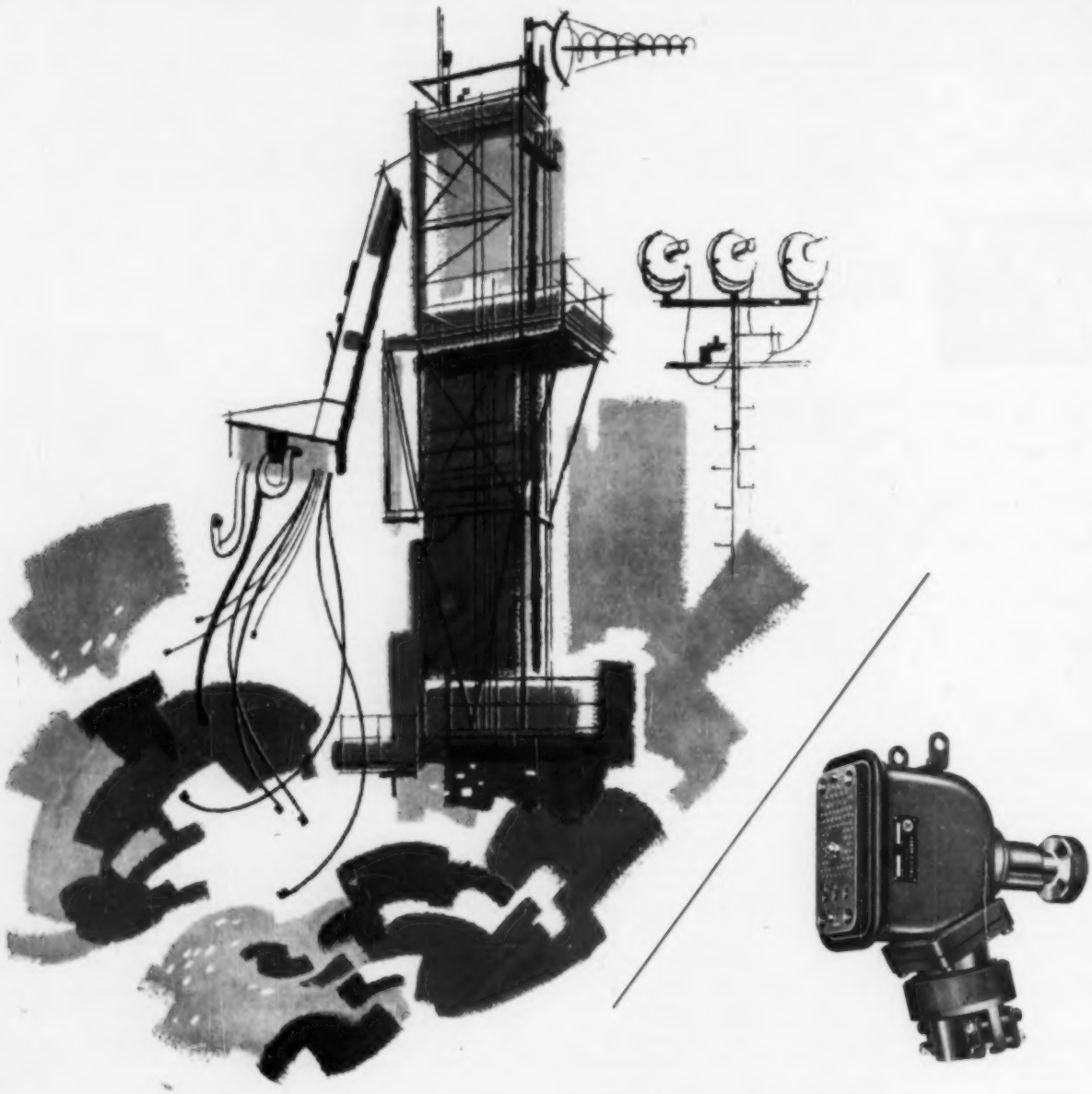
Space Vehicles

★**AGENA** (Air Force)	Lockheed, prime; Bell, propulsion	1700-pound satellite after burnout; AGENA B stop-start engine about double fuel capacity of AGENA A	Used in DISCOVERER program; larger AGENA B also to be used with ATLAS and THOR
★**ATLAS-ABLE** (NASA)	STL, prime; GE/Burroughs, Arma, guidance; Rocketdyne, Aerojet-General, ABL, propulsion	Orbit 380-lb. vehicle around moon or send into deep space	Program ended with explosion of booster in flight Dec. 14. Launchings: 4; failures, 4 (3 failed in flight)
BLUE SCOUT (Air Force)	Aeronutronic, prime; Minneapolis-Honeywell, guidance; Aerojet/Hercules, Thiokol, propulsion	Solid multi-stage booster similar to SCOUT	First BLUE SCOUT launching partly successful in September
CENTAUR (NASA)	Convair, prime; Pratt & Whitney/JPL, propulsion; Minneapolis-Honeywell, guidance	Pair of LOX-liquid hydrogen engines, 30,000 lbs. total thrust, atop ATLAS booster, capable orbiting 8500 lbs. launching 1450-lb. space probe	First test flight in 1961; first engine delivered
★**DELTA** (NASA)	Goddard, prime; Douglas, booster; Bell, guidance; Rocketdyne/Aerojet/ABL, propulsion	Successor to THOR-ABLE; upper stage guidance; 480 lb. payload capacity	Interim launch vehicle for TIROS-ECHO; to be used for other satellites and one deep space probe
JUNO II (NASA)	Marshall Center/Chrysler, prime; Ford Instrument, guid.; Rocketdyne/JPL, propulsion	Early deep space booster; small payload	Two more shots planned
MARINER (NASA)	JPL, prime	600-1200 lb. unmanned spacecraft for early interplanetary missions; boosted by ATLAS-AGENA B	Seven shots planned beginning next year
MERCURY (NASA)	NASA, prime; McDonnell, capsule	First manned satellite; 1 ton capsule boosted by ATLAS	Program slipping about one year. First manned capsule launching by REDSTONE down Atlantic Range slipped to early 1961. First manned orbit shot scheduled for late 1961
NOVA (NASA)	No prime announced; Rocketdyne, propulsion	Clustered 6-9 million lb. booster plus upper stages	R&D on 1.5 million lb. F-1 engines
ORION (Air Force)	General Atomic	Space station launched by series of atomic explosions	Advanced engineering studies under way; tests may be attempted; program shifted to Air Force alone
PROJECT 3059	Aerojet-General, Grand Central, propulsion	Solid motor in 1 million to 2 million lbs. thrust class	Research determining feasibility; NASA contracting complementary studies with United Technology
★**ROVER** (NASA, AEC)	No prime announced	First nuclear rocket	Contracts to be let early 1961
★**SATURN** (NASA)	Marshall Center, prime and booster; Douglas and Convair, upper stages; Rocketdyne, booster and mid-stage engines; Pratt & Whitney, top-stage engines	Series of multistage vehicles based on 1.5-million-lb. clustered booster and various upper stages of LOX-liquid hydrogen engines. Early model to orbit 20,000-lb. payload	Second series of static firings in progress; first flight test spring of 1961; flight with live upper stages scheduled 1963
★**SCOUT** (NASA)	Chance Vought, prime; Minneapolis-Honeywell, guidance; Aerojet-General/Hercules/Thiokol/ABL, propulsion	Solid four-stage satellite launcher; 200 lb. payload in orbit	First four-stage flight successful in Oct.; orbital shot failed in December.
THOR-ABLESTAR (Air Force-NASA)	STL, prime; Rocketdyne/Aerojet-General/ABL, propulsion	Three-stage vehicle, orbital capability 800 lbs. Upper stage has restart engine	THOR-ABLE phased out. THOR-ABLESTAR operational in TRANSIT and COURIER

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
THOR-AGENA (Air Force)	Lockheed, prime; Bell, propulsion	Two-stage vehicle capable of orbiting more than 300 lbs. AGENA-B restartable upper stage boosts payload capacity to 1250 lbs.	Operational in DISCOVERER program. AGENA-B first used May 24 to launch MIDAS II. NASA to use extensively beginning late '61
TRIBE (ARPA)		Family of space launching vehicles	Planning

Satellites in Orbit

SATELLITE	COUNTRY	STATUS
★**EXPLORER I** (30.8 lbs.)	U.S.	Launched 1/31/58, est. life 3-5 years. Orbits earth, perigee: 217 m., apogee: 1155 m., period: 107.2 min. (Discovered Van Allen Belt); not transmitting.
★**VANGUARD I** (3.25 lbs.)	U.S.	Launched 3/17/58, est. life 200-1000 years. Orbits earth, perigee: 403 m., apogee: 2447 mi.; period: 133.8; still transmitting.
★**LUNIK I "MECHTA"** (3245 lbs.)	RUSSIA	Launched 1/2/59. Believed to be in orbit around sun on 15 mo. cycle; not transmitting.
★**VANGUARD II** (20.7 lbs.)	U.S.	Launched 2/17/59, est. life 10 years +. Orbits earth but is "wobbling," perigee: 348 m., apogee: 2049, period: 125.4 min., inclination to equator: 32.88°; not transmitting.
★**PIONEER IV** (13.40 lbs.)	U.S.	Launched 3/3/59. Orbits sun, and achieved primary mission, an Earth-Moon trajectory; not transmitting.
★**EXPLORER VI "PADDLE-WHEEL"** (142 lbs.)	U.S.	Launched 8/7/59, est. life: to Aug. 1961. Orbits earth, former perigee: 156 m., former apogee: 26,357 m., former period: 12½ hours, present orbit uncertain speed: at perigee 23,031, at apogee: 3126 mph., inclination to equator: 46.9°; not transmitting.
★**VANGUARD III** (about 100 lbs.)	U.S.	Launched 9/18/59, est. life 30-40 years. Orbits earth, perigee: 320 m., apogee: 2313 m.; period: 129.8; not transmitting.
★**EXPLORER VII** (91.5 lbs.)	U.S.	Launched 10/13/59, est. life 20 years, orbits earth, perigee: 344, apogee: 671; period: 101.1; transmitting
★**DISCOVERER V CAPSULE** (less than 300 lbs.)	U.S.	Launched 8/13/59. Satellite burned up in atmosphere Sept. 28. Capsule also thought to have been destroyed, but it was later rediscovered and first thought to be an unidentified Soviet satellite. Est. life several months; period: 94.2; perigee: 123, apogee: 470.
★**PIONEER V** (94.8 lbs.)	U.S.	Launched 3/11/60, est. life: forever; orbits sun, interplanetary radio communication satellite, passed 20 million miles June 20; not transmitting.
★**TIROS I** (270 lbs.)	U.S.	Launched 4/1/60, perigee: 429 m.; apogee: 465; period: 99.1 Picture-taking weather satellite; still transmitting.
★**TRANSIT IB** (265 lbs.)	U.S.	Launched 4/13/60, est. life: 16 mos. minimum; perigee: 238; apogee: 426; period: 95.2. First R&D navigation satellite. Not transmitting.
★**SPUTNIK IV** (10,008 lbs.)	RUSSIA	Launched 5/15/60; est. life: relatively brief; original perigee: 188; apogee: 229; changed to 191/429 on May 19. Last reported—Period 93.4; perigee: 175; apogee: 372. Test of support systems, cabin, for manned space flight; attempt to return from orbit failed because of poor orientation of retrorocket; not transmitting
★**MIDAS II** (5000 lbs.)	U.S.	Launched 5/24/60; est. life: 40 months; perigee: 300; apogee: 315; period: 94.3; Telemetry for IR scanning failed two days after launch; still transmitting.
★**TRANSIT II-A** (223 lbs.)	U.S.	Launched 6/22/60; est. life: 50 years; period: 101.6; perigee: 389; apogee: 650; still transmitting.
★**NRLI "GREB"** (40 lbs.)	U.S.	Launched 6/22/60 with TRANSIT 11-A; period: 101.6; perigee: 381; apogee: 657. Solar radiation measuring satellite; still transmitting.
★**ECHO I** (132 lbs.)	U.S.	Launched 8/12/60; est. life: one year; period: 117.5; perigee: 628; apogee: 1324; first successful orbiting of a passive communications satellite.
★**COURIER IB** (500 lbs.)	U.S.	Launched 4/10/60; period: 106.8; perigee: 586; apogee: 767; first successful launching of a delayed active repeater satellite; est. life one year; transmitting.
★**EXPLORER VIII** (90 lbs.)	U.S.	Launched 3/11/60; period: 112.6; perigee: 259; apogee: 1420; launched by JUNO II; providing ionospheric measurements for communications work; est. life 2-3 months; transmitting.
★**DISCOVERER XVII** (2100 lbs.)	U.S.	Launched 12/11/60; period: 94.2; perigee: 114; apogee: 478. Capsule recovered by air snatch after 31st orbit for first time instead of 17th; contained human biological specimens that were exposed to intense radiation.
★**TIROS II** (280 lbs.)	U.S.	Launched 11/23/60; period: 98.1; perigee: 378; apogee: 459; transmitting.
★**DISCOVERER XVIII** (2100 lbs.)	U.S.	Launched 7/12/60; period: 94; perigee: 150; apogee: 450. Capsule recovered and air snatched after 48 orbits; contained human bone marrow, cancer cells, other biological specimens.



CANNON UMBILICAL PLUGS

FOR THE SPECIALIZED DEMANDS OF MISSILE LAUNCHING Cannon Umbilical Plugs are designed to provide the utmost reliability in connections between complex electronic systems within a missile and a master control point or other ground systems. Cannon is a pioneer in umbilicals and associated equipment; our research and development has kept pace with the expanding space program and can provide umbilicals to meet any challenge of missile launching. Our Phoenix Plant specializes in every phase of engineering, manufacturing, and testing—produces umbilicals compatible with any method of launching, any method of engagement and release. If you have standard or specialized launch requirements, consult the first name in plugs. Write for complete information to:

CANNON ELECTRIC COMPANY, 3208 Humboldt Street, Los Angeles 31, California

CANNON PLUGS

Circle No. 5 on Subscriber Service Card.

Technical Countdown

ELECTRONICS

'Electronic Catalogue' Will Speed DOD Supply

DOD has begun using new electronic supply information equipment designed to double the capacity of present methods. Up to 100,000 individual supply management actions can be handled each day. Heart of the system installed at Armed Forces Supply Support Center in Washington is an IBM 705-III electronic computer. The system's memory can magnetically store 1 billion characters of supply information covering 3.5 million items.

Electronics Shows Gain in 1960

The electronics industry will set a new all-time high of $9.75 billion in factory sales for 1960—a 6% rise over 1959—says the Electronic Industries Association. And another rise of 6% to a $10.3 billion total in 1961 is predicted by EIA. Industrial products will be the biggest gainer, with military products close behind.

Patent Granted on Semiconductor Radiators

A patent for 17 claims on semiconductor radiators has been granted to the Birtcher Corp. The patent (number 2,958,515) covers some 80-odd fin-type radiators.

Aggies and Taws Speed Circuit Etch

The Army Signal Corps has cut the time required to etch a printed circuit from 2½ hours to seven minutes by using glass marbles. Costs are reduced by about 40%. The marbles, immersed in the etching bath are oscillated against the circuit board's surface to speed and improve the etching process.

EIA Hits Tube/Transistor Imports

Electronic Industries Association has stepped up its campaign against the import of tubes and transistors with the distribution of a new booklet to 30,000 industry and government officials, technicians and purchasing agents. The little booklet, "Plus Values," takes the positive approach and presents some strong arguments for buying U.S.-made components—chiefly availability, services, and economic benefits.

'Helium Bomb' Tests Transistors

Transistor container leak rates as low as 10^{-8} cc/sec. reportedly can be monitored by a "helium bomb test" being used by Delco Radio. The method is more satisfactory and yields higher reliability than the previously used water vapor test.

SUPPORT EQUIPMENT

SS-FM Extends Telemetering Capacity

A new data multiplexing system to be used in *Saturn* combines single-sideband and FM and permits transmission of about 45 kc of data with 5% accuracy in the same r-f bandwidth used by FM-FM for 4 kc. In addition to a more-than-tenfold improvement in bandwidth utilization efficiency, up to 30 db improvement in S/N can be realized with the new technique.

Signal Enhancement Ups Radar Efficiency

Simple signal enhancement operations can add radically new dimensions to existing radar according to a study completed by General Atronics Corp. for the Air Force. Results show that equipment can be designed for making direct measurement of speed, acceleration, and spin of targets from radar echoes. The theory also has application to sonar and pulsed communications systems.

PROPULSION

Screech and Chugging Under Study

Missile fuel supply failures due to "screech" and "chugging" are being studied by the University of California's Engineering Field School. Screech—a high-frequency phenomenon occurring when chemical reactions of two fuels resonate with combustion chamber volume—causes exhaust gases to punch holes in the chamber walls. Chugging—a lower-frequency effect due to uneven burning rate—results in an intense pressure-wave buildup which can blast or burn off the nozzle end.

Pershing Motors Ready for Production

Thiokol is getting ready for the production run on *Pershing* propulsion units at Longhorn Arsenal, Marshall, Tex. A recent $1,139,675 contract will be used to procure motor cases from Curtiss-Wright and manufacture other inert motor component parts. Army spokesmen say Pratt & Whitney will continue R&D cases. Curtiss-Wright is a second source. It isn't certain whether Thiokol's continuous mix process will be ready for the start of production, probably in mid-summer.

ADVANCED MATERIALS

Rubber-Ammonia Compatibility Tests Developed

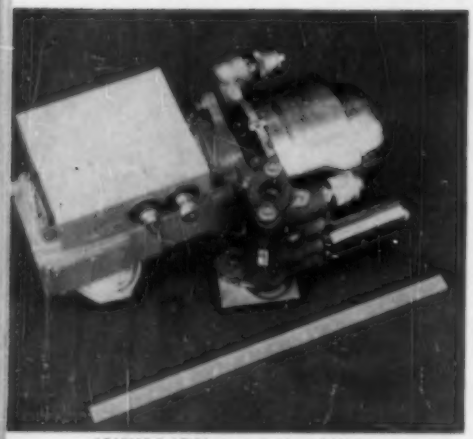
Procedures for determining the compatibility of rubber materials with anhydrous ammonia have been developed by laboratory engineers at North American Aviation's Missile Division. Prior to the development, little or no information on the problem was available to industry. The need for the tests developed when an O-ring was required in the anhydrous ammonia cooling system on the *Hound Dog* missile and its pylon.

Soviets Have Large Scale Vacuum Degasser

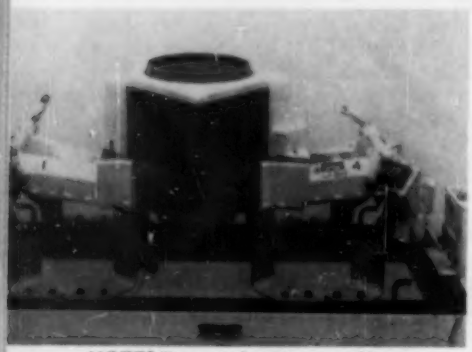
The largest vacuum degassing unit in the USSR, located at the Kramatorsk machine building plant, can accommodate up to 200 tons of molten steel. The plant is conducting experiments with vacuum degassing during the process of pouring from furnace ladle to pouring ladle. The possibility of using vacuum-degassed steel instead of acid open-hearth steel is also being studied.

Minuteman Flight Control Aims at Lo

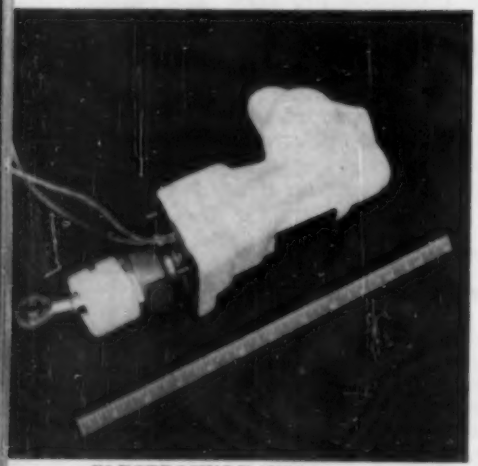
Details of Autonetics system which will be key to superior performance of the solid-fueled second-generation intercontinental missile



AUXILIARY power for Minuteman controls.



NOZZLE control unit assembly.



ELECTROHYDRAULIC servo actuator.

DOWNEY, CALIF.—The flight control system for *Minuteman* stresses simplicity, reliability and—because the ICBM is completely inaccessible in its silo—low maintenance.

"*Minuteman* is not a larger or more accurate missile," said Autonetics engineers L. J. Purpura and A. O. Greer, who spelled out details of the system. "It is only better insofar as its design philosophy and its reliability will carry it."

In the assembled *Minuteman*, they point out, the flight controls cannot be reached for repairs or even minor adjustments. Any malfunction or intolerable drift calls for a major missile disassembly.

• **Self-contained set-up**—Flight control is provided by a nozzle control unit (NCU) on each of the three *Minuteman* stages, giving pitch, yaw and roll control. Each NCU contains four electro-hydraulic position servos with associated equipment.

The missile hydraulic system is comprised of the four servo actuators and an auxiliary hydraulic supply, all married to a common platform. This platform serves as the hydraulic manifold, which features subassemblies of the plug-in type and uses internal ports as fluid ducts. It also serves as the component and subassembly mounting structure and the base structure for the fully integrated, closed hydraulic system.

The entire system is self-contained, and no external supply equipment is required. The system is cleaned, filled and bled in a controlled manufacturing area; field maintenance is not permitted.

• **Single-unit APS**—The auxiliary power supply (APS) converts DC current from either a ground power source or an airborne battery into hydraulic power. The APS is essentially a constant pressure source capable of simultaneously supplying a specified maximum servo-actuator velocity for all nozzles.

An integrated single unit, the APS consists of: motor assembly, noise filter and thermistor; pump assembly; check valve; filter; remote pressure indicator or switch; fill and vent quick-disconnects; bootstrap reservoir; and pressure transducer (for telemetry purposes only).

• **Praise for pump**—The hydraulic pump is coupled directly to a nominal 27v DC compound wound motor. Weight-to-output horsepower for this unit is about 2.3 lbs./hp. Due to large variations in the system power demand, a variable delivery pump is used to minimize energy consumption. Overall efficiency at minimum pump-flow demand is about 16.5%, and at peak power output about 63%.

Autonetics praised the Vickers, Inc. pump, which was developed for the system within five months of the contract award.

"Packaging concepts and weight considerations induced a rapid advancement in the state-of-the-art of hydraulic pumps," Autonetics said, describing the high-speed unit as a miniaturized, 905-series, fixed-angle, variable-displacement pump.

In this system, inlet pressurization obtained from the bootstrap reservoir is about 85 psi. The pump is designed to operate for rated continuous duty up to 18,000 rpm. Overall efficiency of the 25-degree-angle pump at full flow is about 82% at 12,600 rpm.

The remote hydraulic pressure switch used is a bourdon tube-switch combination. In operation, hydraulic pressure within the coiled bourdon tube causes it to unwind slightly, opening or closing the switch contacts within specified pressure ranges. (For example, the switch is open between 0-2800 psig, closed from 2800 to about 3350 psig, and open at higher pressures.)

The bootstrap reservoir is a fluid-storage sump; during APS operation it provides pump supercharge pressure through feedback of pump supply pressure to a differential area. The supply pressure to reservoir pressure is inversely proportional to the respective pressure-acting areas.

In the non-operating state, the mechanical bellows spring force overcomes the internal seal friction to compensate for fluid volumetric changes. No external dynamic seals are used. The stainless steel bellows can withstand 1000 psi steady-state pressure.

Drilled internal passages provide

NAME _____

TITLE/POSITION _____

COMPANY _____

Product Mfg./Service Offered _____

ADDRESS _____ ☐ HOME? ☐ BUSINESS?

CITY _____ ZONE _____ STATE _____

This card CANNOT be processed unless company affiliation and title are given. Use home address for employment advertisements only. Please limit requests to 10 items.

MISSILES AND ROCKETS

JANUARY 2, 1961

Expires Three Weeks After Above Date

CIRCLE NUMBERS BELOW FOR INFORMATION ON PRODUCTS, LITERATURE OR ADVERTISEMENTS

• • Advertisements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125

• • Missile Literature

200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224

• • New Missile Products

225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249
250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274
275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299

poses
aulic
minal
otor.
this
large
and,
d to
erall
de-
peak

Inc.
the
con-
eight
ance-
aulic
g the
905-
lace-

ation
ir is
d to
up to
the
w is

sure
ritch
aulic
tube
g or
peci-
the
psig,
psig.

luid-
ation
sure
pres-
pply
in-
tive

the
ver-
om-
ges.
sed.
with-
e.
vide

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY ADDRESSEE

BUSINESS REPLY MAIL

First Class Permit No. 2455-R Washington, D. C.

MISSILES and ROCKETS

1001 VERMONT AVENUE, N.W.,

WASHINGTON 5, D. C.

SUBSCRIBER SERVICE DEPT.

WASHINGTON 5, D. C.
SUBSCRIBER SERVICE DEPT.

aintenance

porting for the hydraulic fluid (MIL-H-5606) in the APS manifold. Pump output is diverted through a modularized check valve to a common cavity which ports fluid to the hydraulic filter and vent disconnect. The remote pressure indicator and instrumentation transducer are located in the manifold, downstream from the filter. The filter (MIL-F-8815) has a rating of 15 microns absolute and a pressure drop of less than 10 psi at 3 gpm flow.

The APS transient response characteristics satisfy system requirements without the aid of a conventional accumulator. The time constant realized is 30 milliseconds or less, which corresponds to maximum acceleration on all four actuators.

Pressure oscillations superimposed on the pump output pressure bias are within 10% of system pressure during the course of the transient period and are completely damped within 0.8 seconds. Due to its compactness, Autonetics says, the miniture pump is easily packaged within the reservoir, thus minimizing the inlet flow restrictions and serving as an excellent heat sink.

The APS, with 10 cubic inches of oil in the reservoir, weighs about 18.2 lbs., including the pressure transducer for airborne telemetering.

• **Servo actuators**—Each of the four servo actuators on each stage is rigidly mounted to the basic platform structure. The piston shaft, connected to a floating link, is thereby connected to the clevis of the movable nozzle. The primary purpose of the floating link is to allow for misalignment between the platform assembly and the engine, and to provide for freedom of motion in the plane nozzle rotation.

Unique features of the servocylinders are:

(1) Modular servovalve eliminates breathing face seals and bolts.

(2) Torque motor separated from the hydraulic fluid minimizes effects of magnetic contamination.

(3) Internally, concentrically mounted feedback transducer provides maximum mechanical and thermal protection.

(4) AC position-feedback element gives essentially infinite resolution without wearing parts.

(5) Three-way servovalve reduces null leakage and the number of seals required.

(6) Wires, routed internally in actuator body and potted in place, provide maximum protection against high vibration and thermal environment.

To reduce the number of seals, the servo actuators employ a single-ended design, rather than the more conventional balanced design. System pressure, constantly applied to the small side of the 2:1 area, applies a retracting force on the ram which is opposed by the controlled ram force from the servovalve control pressure large area product.

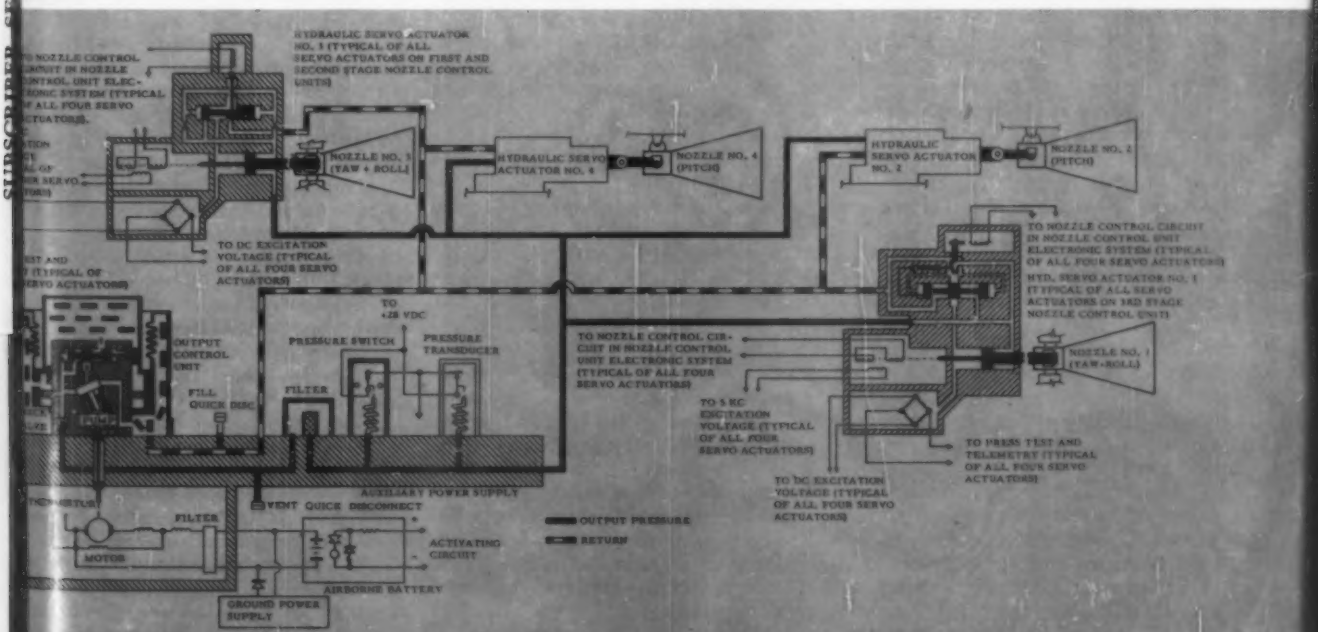
Thus, at a 3000 psi system potential, a net 1600-lb. retracting or extending force can be realized.

The three-way actuator design is inherently weaker in bearing-load capacity than the conventional, balanced double-rod, seal-type actuator, Autonetics said. However, the actuator is mounted tangentially to the movable nozzle clevis when in neutral, and with small angular deflections required, the worst side loading under stall load does not exceed 75 lbs. in any stage.

Seals in the actuator system are elastomeric, and include a single dynamic seal, five redundant pairs and two single static seals. The APS employs a face-type shaft seal, five redundant pairs and eight single static seals. Instrumentation seals are not included in these figures.

Airborne batteries for the *Minuteman* are energized during prelaunch stage, affording an opportunity to conduct a last-minute preflight check on the complete airborne system and also assuring battery activation. A weight premium is significant here, the company said, because the system peak-to-prelaunch valve leakage power ratio is 7:1.

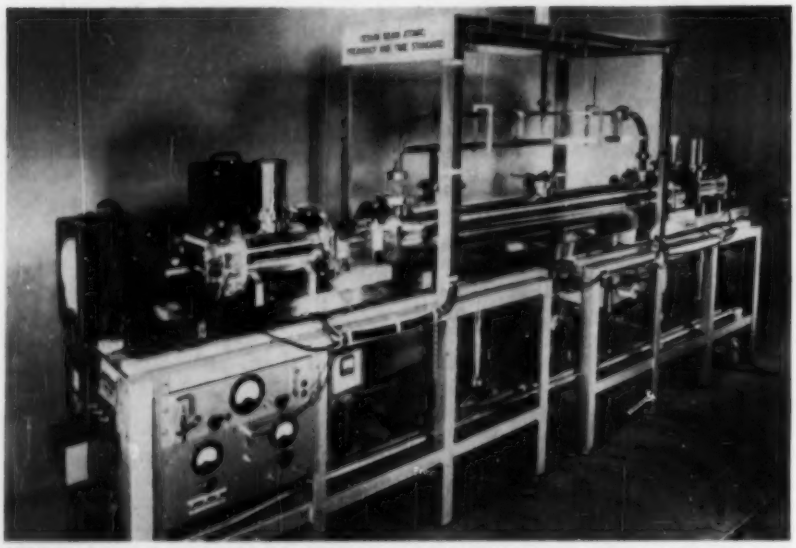
The missile batteries are dry charged, primary silver-zinc type. The electrolyte is stored in a pressurized container and is discharged into the cells upon actuation. ⁂


HYDRAULIC SERVO ACTUATOR NO. 3 (TYPICAL OF ALL SERVO ACTUATORS ON FIRST AND SECOND STAGE NOZZLE CONTROL UNITS)
NOZZLE NO. 3 (YAW + ROLL)
HYDRAULIC SERVO ACTUATOR NO. 4
NOZZLE NO. 4 (PITCH)
HYDRAULIC SERVO ACTUATOR NO. 2
NOZZLE NO. 2 (PITCH)
TO DC EXCITATION VOLTAGE (TYPICAL OF ALL FOUR SERVO ACTUATORS)
TO +28 VDC
PRESSURE SWITCH
PRESSURE TRANSDUCER
OUTPUT CONTROL UNIT
FILL QUICK DISC
FILTER
TO NOZZLE CONTROL CIRCUIT IN NOZZLE CONTROL UNIT ELECTRONIC SYSTEM (TYPICAL OF ALL FOUR SERVO ACTUATORS)
TO 5 KC EXCITATION VOLTAGE (TYPICAL OF ALL FOUR SERVO ACTUATORS)
TO DC EXCITATION VOLTAGE (TYPICAL OF ALL FOUR SERVO ACTUATORS)
TO PRESS TEST AND TELEMETRY (TYPICAL OF ALL FOUR SERVO ACTUATORS)
NOZZLE NO. 1 (YAW-ROLL)
AUXILIARY POWER SUPPLY
VENT QUICK DISCONNECT
FILTER
MOTOR
ACTIVATING CIRCUIT
AIRBORNE BATTERY
GROUND POWER SUPPLY
OUTPUT PRESSURE
RETURN

TYPICAL HYDRAULIC SYSTEM schema for nozzle control units associated with Minuteman guidance and flight controls.

electronics

Cesium Beam Is Leading To Improved Timing Accuracy



NBS-II ATOMIC BEAM frequency standard is larger of the two being investigated at Boulder Laboratories. Separation between the oscillating fields inducing the atomic transition is 164 cm (64.5 in.). Spectral linewidth is 90-140 cps.

NEED FOR EXTREME timing accuracies—for future radio communications, satellite tracking, control of long-range rockets, and astronomical observations—will be met by atomic frequency standards now being researched.

Scientists at Bureau of Standards Boulder Laboratories are currently experimenting with two dissimilar cesium-beam devices which are potentially three orders of magnitude more precise than present methods for time-interval determination. Such an improvement will answer the requirement for accuracies of one part in a billion, or better.

Scientific activities today rely on regular radio transmissions of standard frequencies from Bureau and Navy Stations: WWV, WWVB, WWVH, NBA. These broadcasts are based on astronomical observations related to the earth's rotation as made by the Naval Observatory. A far more accurate basis is needed for future activities, however.

Results of the NBS experiments, based on independent tests and measurements, show that cesium-beam devices of rather modest length (21.6535 in. between the oscillating fields for the shorter machine) can have precisions of $\pm$ 2 parts in 10^{12} for measurement periods of one to a few hours.

The frequency difference between the two machines (10^{-11}) has remained within $\pm$ 2 x 10^{-12} over the last nine months. Researchers feel that even better accuracy—up by at least an order of magnitude—should be attainable with some improvements in the apparatus.

• **Greater precision**—At present, radio transmissions controlled by the Bureau's master quartz-oscillators are being monitored with the cesium beam standards. Corrections for the 60 kc standard frequency broadcasts from WWVB at Boulder, Colorado, are being made each week and are available on request from Boulder Laboratories. Corrections for the 20-kc/s transmission from WWVL will be available shortly.

Prior to the development of atomic frequency standards, the most uniform time-intervals available were those derived from astronomical observations of the rotation of the earth relative to the fixed stars corrected to the orbital motion of the earth about the sun. This orbital motion of the earth is the basis of Ephemeris Time. It has been measured with a probable error of 2 parts in 10^9 in a period of three years. Higher precision is expected for longer measurement times.

Measurement of a frequency or a time-interval in terms of the cesium transition can be made with a precision of $\pm$ 0.2 cps and is not limited by the instrumental difficulties involved in astronomical observations. The precision of measurement for the atomic standards has proved to be two orders of magnitude better over a 2-minute period than astronomical measurements made over a period of 3 years.

The thallium atom as a frequency standard is also under investigation by NBS. Thallium has certain significant advantages over the cesium atom in this application, but may have some disadvantages in practical use. Boulder Laboratories are now putting a thallium beam into operation to determine which of the two atomic techniques is the more suitable. ⌗

Raytheon Develops Device To Study Gas Composition

ENGINEERS AT RAYTHEON have come up with an omegatron mass spectrometer capable of determining the composition of a gas in the 10^{-5} to 10^{-9} M Hg range.

The apparatus consists of a small volume radio-frequency mass spectrometer operating on a cyclotron resonance principle; a very sensitive quartz microbalance which detects 10^{-7} gram weight changes; a system employing a modified Wagener technique to study getter activity and associated vacuum systems using oil, mercury, ion or cryogenic pumping.

Outgassing, sputtering, dissociation, adsorption and oxidation phenomena may be studied over a wide range of pressures and temperatures with the simultaneous identification of species involved.

In operation, the ions formed in the omegatron are separated according to their mass and a measurement of the ionic currents is an indication of their concentrations in the sample of gas present in the analyzing chamber.

Data readings of current and frequency on a recorder chart may be interpreted in terms of concentration of a particular gas as identified by its mass number. By running the available sweep of frequencies, the mass numbers of the low-molecular-weight gaseous components may be successively monitored and relative gas concentration estimated.

The omegatron is useful in examinations of the nature of gases evaporated from hot cathode surfaces; examinations of the penetration of gases through glass and ceramics: investigations of gases absorbed and released from metal surfaces; examinations of residual gases in diffusion pumps; investigations of aging effects in vacuum tubes and control of the composition of light hydrocarbon gas mixtures.

SOCOM to Better Space Communication

Electro-Optical's solar radiation system, tested in desert, offers vast improvements over conventional radio wave systems

PASADENA, CALIF.—Electro-Optical Systems has completed first field tests of a 10-million-mile space communications system which uses solar radiation instead of radio waves.

The tests in the Mojave desert were to establish feasibility and check out prototype equipment.

EOS says the solar optical communications system (SOCOM) will be used in space for vehicles-to-vehicle, vehicle-to-station, and—under certain conditions—even station-to-earth communications.

It is being developed under contract for the Communication Laboratory of the Air Force's Wright Air Development Division.

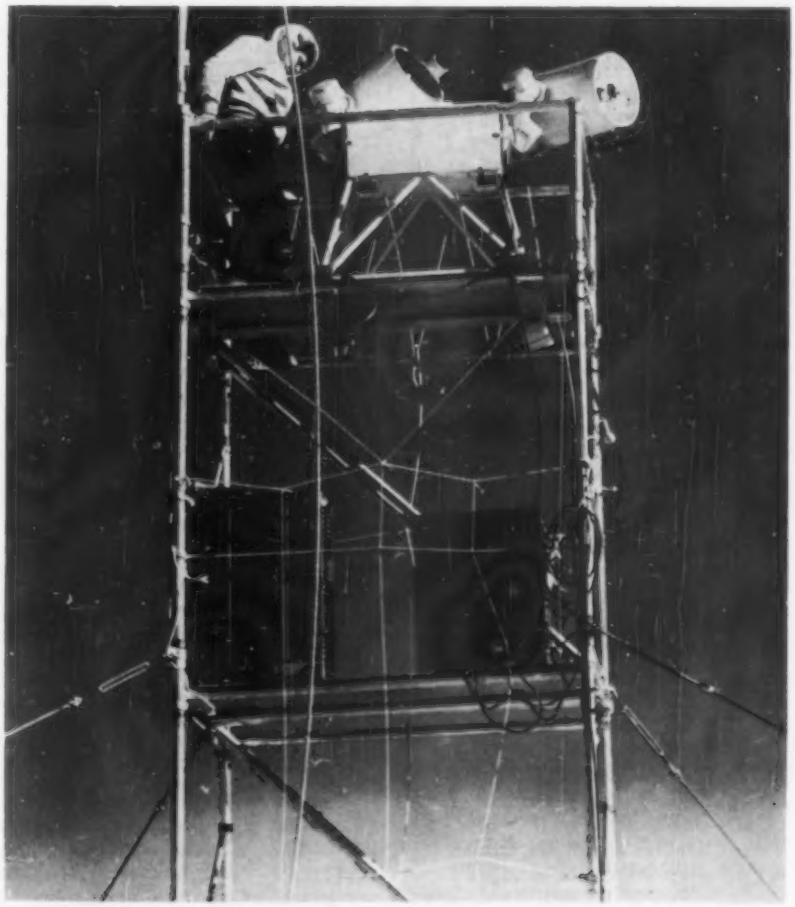
The tests of SOCOM's prototype equipment were conducted over an eight-mile range using both the moon and sun as light sources. The transmission beam from the transmitter's emitting mirror to the receiver's parabolic collecting mirror was purposely attenuated to simulate distances from 1000 to 10 million miles. EOS engineers believe that in space, using the sun as the light source, SOCOM will be able to exceed 10 million miles with its signals, because of its highly directive antenna and high signal intensity.

• **Big weight, power advantages**—Several types of modulators for coding the light beam were used during the tests. Among these, the most suitable was a stressed plate shutter developed recently by EOS for the Army. This device has the advantages of light weight and low power requirement (approximately 3000 volts), and can accommodate large amounts of radiation without overheating.

Equipment used in the desert testing was far heavier than that which would be used in space. For instance, heavy glass mirrors were used to obtain high optical perfection at minimum cost. Actual weight of a space-launched SOCOM system is expected to be 30 to 40 lbs.

Electro-Optical explains that potential advantages of SOCOM over conventional radio frequency systems include lower weight and power requirements, more secure communications due to narrow beam width, superior reliability (from lack of high-power electronic components), longer range, invulnerability to electronic countermeasures, and a high signal-to-noise ratio in space.

In actual space use, SOCOM's operational cycle begins with collection of the sun's rays in a mirror antenna system. Radiation is then funneled through a modulator for coding and on into a second mirror system for emission through space to the receiving unit. The receiving unit also uses a mirror antenna system for collecting the signal. This signal is concentrated onto a detector at the focus of the antenna and then fed into a signal processing unit and finally read out. ⌗



EXPERIMENTAL SOCOM transmitter on a 30-ft. tower during tests in the Mojave Desert. Both the sun and the moon were utilized as sources of light.

TFE Is Unperturbed by Radiation

Insulation's high performance under space conditions has been proven both in lab tests and in transmissions from satellites

THE RAVAGES OF space radiation have little effect on the dielectric properties of DuPont's "Teflon" TFE and FEP resins—a happy fact which ensures constant communications with long-lived satellites.

Laboratory evaluations of TFE fluorocarbon resins show a net change in weight of less than 0.003% after 72 hours exposure to a Cobalt-60 source in a 10^{-6} mm. Hg vacuum and at a temperature of 100°C.

"The resins have already proven their stability in space," says James P. Shoffner of DuPont's Polychemicals Dept., "fully 80% of the internal hookup wire in the *Explorer* series has been insulated with the TFE resins."

Pioneer V, which provided uninterrupted transmissions past the 5-million-mile mark, used an unprotected TFE-wrapped construction for the link between the paddle-arm solar cells and the vehicle.

Vanguard I is still broadcasting after 18 months, aided by fluoropolymer flush-fitting, feed-through insulators for the antenna system. Any degradation of the insulator would have resulted in antenna shorts—and communications failure.

Teflon Under Radiation

	Radiation Dose,* x10^6 Rads	Elongation, %	Tensile Strength, Psi.	Dielectric Constant (±0.05)
Atmospheric	0	165	3,000	2.1
	0.1	152	1,882	2.1
	0.5	37	1,539	2.1
	1.0	21	1,388	2.1
	5.0	—	1,322	2.1
Vacuum 10^{-6} mm. Hg	1.0	92	2,481	2.1
	5.0	73	1,972	2.1
	51.0	38	1,462	2.1
	150.0	16	800	2.1

SAMPLE—0.010 TFE resin film at 25°C.

• **Nature of radiation**—Shoffner said the various changes observed for irradiated plastics in either oxygen or vacuum environments can be understood if the existing types of radiation are considered.

There are two general classifications of radiation—electromagnetic and high-energy particles.

Electromagnetic energy includes radio transmissions with wavelengths several thousand meters in length, radar (meters to centimeters), infrared radiation, ultraviolet radiation, X-rays and gamma radiation.

Particle radiation encompasses tiny masses with varying weight and charge. With Teflon in mind, the most important are electrons, high-energy positive ions and neutrons.

In general, says Shoffner, when gamma or beta rays are absorbed by any material, there results both ionization and excitation of the molecules irradiated. Coincidentally, free radicals are formed.

The chemical changes occurring with formation of these radicals determine the extent of change in the polymer's physical and chemical properties.

Free radical formation can occur at any point in a complex molecule, and the extent of alteration is a function of electron density. Electrons and high-energy protons can produce considerable damage in all kinds of materials.

Protons with energy levels of 60-80 Mev exist in the lower Van Allen belts. These levels are appreciably above the inter-molecular binding energies of all chemical compositions.

High-energy neutral particles are present in the belts and in outer space. But neutron bombardment is of less importance in fluorocarbons than in hydrocarbons, says Shoffner. This is because of the fluoropolymer's lower capture cross section.

For example, the energy absorption of a Teflon TFE resin from fast neutrons is about 3% that of polyethylene. Minimized energy absorption is of prime importance in dielectric applications where original material properties must be maintained.

• **Design considerations**—Shoffner draws two conclusions from thermochemical calculations of bond energies for C-C and the C-F linkages of Teflon fluoropolymers. (58.6 and 107.0 kcal/mol, respectively).

The first is that C-C scission will predominate in competition with C-F scission as the energy-absorbing reaction. Fragment radicals of C_2F_6 and higher categories will result.

Secondly, free fluorine will not be liberated in preference to higher order C-F radicals under these circumstances, whether in air or vacuum. Experimental data has confirmed this.

Shoffner says that the use of Teflon fluorocarbons in space involves the following design considerations:

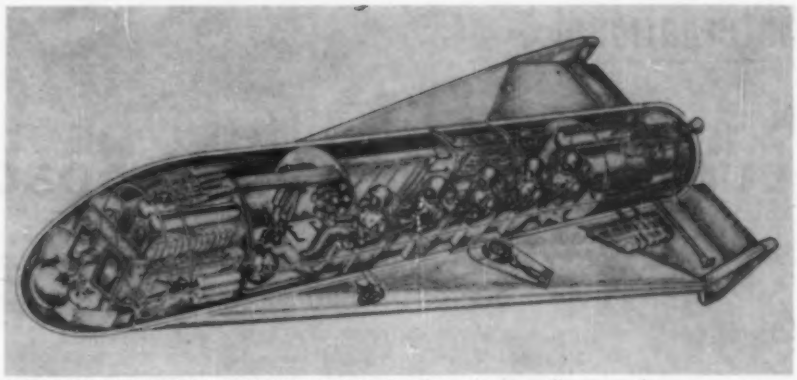
–With longer wavelength radiation, energy absorption will be exhibited as thermal heating. For applications involving skin temperatures of re-entry, these thermal effects are to be expected and adequacy will depend on temperature stability considerations.

–Space radiation intensities are such that ionization or activation is to be expected in spite of molecular composition. The behavior subsequent to, or during irradiation provides the true criteria for materials selection. Behavior refers to cross linking, favorable radical formation, etc.

Vacuum data places Teflon above the service levels for electronic hardware such as transistors, certain capacitors and specific glasses. ⁂

Martin Co. Now Strictly Missile/Space Business

Firm delivers last of 12,000 airplanes, expects space work to compensate for any defense drop



MARTIN VERSION OF SLOMAR shuttle vehicle will carry five men, or an equivalent amount of equipment, to a rendezvous in orbit with a space station. After delivering its load, the vehicle will return to earth by a glide re-entry pattern, slowing in the earth's atmosphere to landing speed.

BALTIMORE, MD.—The Martin Co. moved entirely into the missile/space age Dec. 20 with the delivery of its last airplane, a P5M-2, to the Navy. Thus ended more than 50 years of aircraft manufacturing by Martin, which produced more than 12,000 planes.

Martin president William Bergen said that there was little fear that the defense industry would be out of business if peace should break out. Loss of defense business, he said, would be "more than offset with corresponding gains in the space business and in the business of devising and producing the complicated mechanisms of global surveillance that will be vital to keeping the peace once it has been achieved."

Already big in the aerospace business—which it entered in 1948 with the *Viking*—Martin expects to see sales this year pass the $600 million mark. Recent contracts awarded the company include a $250,000 study contract on *Apollo* and one for $140,000 on *Slomar*. Both these projects involve advanced manned space vehicles.

Glenn L. Martin, founder of the company, built his first airplane in 1909—a bamboo-and-wire "kite with a motor" that flew from a California bean patch. Four years later he delivered to the Army his first military airplane, a model TT biplane that became the world's first bomber. In 1918, the company received an Army order for 20 of America's first twin-engine bombers, the MB-2, which became the Army's standard bomber for many years.

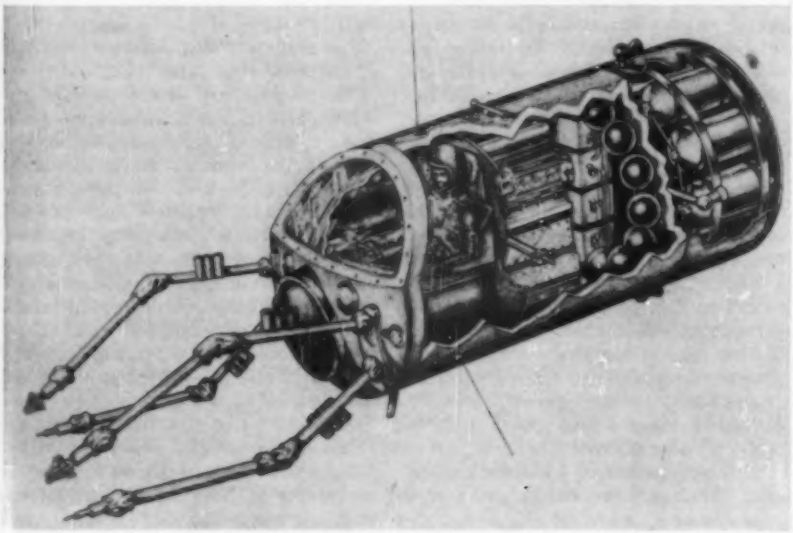
Later military models included the Navy's MC-1, first U.S. all-metal monoplane, the SC torpedo reconnaissance plane, the TM, and the Army B-10, which won the Collier Trophy.

During World War II, Martin built over 5000 B-26s for the Army and hundreds of PBM patrol bombers for the Navy. Other famous models included the Mars "flying warehouse," the China Clippers, the B-51, the B-57 (modified from the British Canberra), and the ill-fated P6M jet seaplane.

Martin entered the field of rocketry with the *Viking* high-altitude research rocket which set world altitude records and provided the background for Project *Vanguard*.

Its first Air Force missile was the *Matador*, first of a long string of operational missiles built or building by Martin. These include the AF and Navy *Bullpup*, AF *Mace*, Army *Lacrosse* and *Pershing*, and AF *Titan* ICBM. A modified *Titan* will provide the first-stage propulsion for *Dyna-Soar*.

Martin also has gone heavily into electronics and nuclear power units to supplement its aerospace activities. Typical of its activities in these areas is the Missile Master electronic air defense control system for the *Nike* missile, and SNAP III, a small nuclear power unit for space application. ⌗



ONE-MAN SPACE TUG being studied by Martin under the Slomar contract would be used for assembling a large space station in orbit. The tug would be equipped with power tools and remotely controlled manipulators operated by the technician inside the vehicle. The 8000-lb. tug would contain a computer, an autopilot to prevent tumbling, a reaction motor and supplies for 48 hours.

Europeans Map Joint Space Research

Preparatory panel to determine what might be accomplished by 10-nation group; U.S., British Space Vehicles may be sought

by Anthony Vandyk

GENEVA—A European space research organization is likely to be set up in about a year's time.

At an intergovernmental conference on space research held here last month, 10 European nations signed an agreement setting up a commission to prepare for establishment of a permanent organization for collaboration in space research.

The agreement comes into force when six member states, whose contributions amount to at least 70% of the $192,838 budget, have either signed it without a reservation as to ratification or else ratified it after having signed it subject to such a reservation. The following nations signed without reservation: Belgium, Netherlands, Norway, Sweden and the United Kingdom. The following signed with reservations: Denmark, France, Italy, Spain and Switzerland. West German will sign later.

• **French headquarters**—The Preparatory Commission will work out of Paris under the presidency of Professor Pierre V. Auger, noted French space research expert. He will be assisted by two vice presidents and a small secretarial staff. The first meeting of the Preparatory Commission will be convened in Paris within 30 days after the agreement goes into force, probably early this year.

The most important task of the Commission will be to determine the scientific program for the permanent organization. The limiting factor here will be cost. Moreover, the programs will have to be related to payloads actually feasible, the orbits and the firing program.

Following are types of satellites on which research might be carried out by the organization: a) 500-kilogram satellites, highly stabilized on universal axes; b) 250-kilogram satellites, stabilized on terrestrial axes; c) sun-orientated satellites, weighing less than 250 kilograms; and d) non-stabilized satellites weighing between 50 and 100 kilograms.

The Preparatory Commission will have to study the possibilities in obtaining vehicles and using launching sites. It is hoped that the British will allow *Blue Streak* to be used as a first-stage rocket. The permanent commission will also consider under what conditions U.S. missiles such as *Thor* and *Atlas* might be secured.

• **Launch sites**—It will also investigate whether the French missile range at Colomb-Béchar and the Australian range at Woomera could be used as launching sites for the organization's work. A check will also be run with the U.S. government to see whether the organization might be permitted to make use of the facilities at Cape Canaveral.

It is expected that a fairly large part of the permanent organization's budget will be devoted to research in such fields as propulsion, power sources, information storage and transmission, solid state physics, surface coatings of controlled emissivity, high vacuum technology, sensitive detecting devices, and the behaviour of materials under high vacua.

Another suggested role for the permanent organization is the investigation of the possibilities of setting up and using telemetry networks and tracking stations both for satellites of the Earth in reasonably near orbits and for deeper space probes. The possibilities are: a) use of the existing facilities with the study of the conditions of their use; b) development of facilities of this kind; and c) the setting up of new stations.

The proposed program for vertical rocket soundings by the European organization will include the following studies: 1) synoptic study of the atmosphere from 30-90 kilometers; 2) synoptic study of the atmosphere in the region of 90-200 kilometers; and 3) study of solar activity.

• **Light orbiters**—In the satellite field, the first phase of the permanent organization's program might include the putting in orbit of small satellites (of the order of 100 kilograms). Such satellites would be sufficient to carry out research requiring no heavy scientific equipment, they would permit to build up European scientific teams with enough experience to make a full contribution to space research.

This first phase might last about three years and would entail the following steps: 1) detailed study of ionospheric structure, constitution and temporal behavior, together with continuous monitoring of solar activity in the ultraviolet and X-ray regions; 2) radioastronomy in the regions of the radio spectrum inaccessible from the ground; 3) meteorological studies; 4) geodetic and time measurement problems; 5) study of cosmic rays and other particles (including meteors) in the upper atmosphere.

A second phase, coming into play after five years, would see the launching into terrestrial orbit of 500-1000 kilogram satellites, and the sending into the lunar field of lighter payloads. More elaborate satellites, endowed with highly stabilized devices, would then be developed.

During this second phase, the following experiments might be undertaken: 1) detailed study of stellar ultraviolet and X-ray spectra; 2) detailed study of solar disk in ultraviolet and X-ray regions of the spectrum; 3) study of interplanetary and interstellar absorption; 4) study of cosmic rays and other particles in interplanetary space; and 5) advanced meteorological studies.

The third phase, which should be developed in parallel with the first two, would include studies and projects likely to evolve during the following years into development of devices capable of landing scientific equipment on the moon, exploring other planets and studying the sun's neighborhood. These studies would deal with: 1) lunar and planetary physics; 2) astronomy; 3) space biology.

To carry out such a program, the permanent organization would have to: 1) proceed immediately to ensure the availability of launching potential for payloads weighing about 100 kilograms; 2) proceed immediately to ensure the availability of means for providing highly stabilized satellites and deep space probes; and 3) undertake, from

(Continued on page 40)

Astropower Head Outlines R&D Plans

SANTA MONICA, CALIF.—Y. C. Lee, president of Astropower, Inc., the new propulsion subsidiary of Douglas Aircraft Co., says the firm will carry out substantial research and development programs in nuclear, chemical and electrical propulsion.

Lee outlined long-range plans and programs of the new firm in a recent interview.

He said Astropower's interest in chemical propulsion will lead into research of extremely high-energy chemical propellants, storable propellants and the combination of cryogenic propellants with additives to form a tribrid system.

Lee reported that Astropower plans investigation of thermal arc plasma engines, ion engines and colloid or heavy-charged particle engines. Major activity is also expected in solid-state devices and energy conversion equipment. This technique, Lee suggested, might be used for micro-thrust rocket engines and to power the various systems in space vehicles.

• **Technical autonomy**—Although Astropower was organized as a Douglas subsidiary, its relationship is purely financial, Lee reported, and all technical programs will be completely separate. Astropower services will be offered to government agencies and major systems contractors, including Douglas itself. The firm also plans to develop commercial products.

Permanent home for Astropower probably will be in the vicinity of Newport Beach, Calif., according to Lee. Sites there are now being surveyed.

"Initially we are planning the construction of a building that will house research laboratories, engineering quarters and administrative offices," he said.

Equipment in the laboratories is to include a hypersonic plasma tunnel to investigate the behavior of ionized gases and an extremely high-vacuum facility to simulate space environment.

• **Organization**—The professional staff of Astropower is to number between 100 and 150 in the first year, plus supporting administrative personnel. The technical staff will be headed by chief engineers in the fields of chemical propulsion, nuclear propulsion, electrical propulsion, power equipment and power source systems.

In addition, Astropower will have chief scientists directing research activities in plasma physics, solid-state physics, magnetohydrodynamics and materials. ⌗

AIA's Cook Sees No Change in Sales

NO SURPRISES are in sight during 1961 for the aerospace industry.

Indeed, Aerospace Industries Association President Orval Cook forecasts that the industry's sales volume will remain exactly at the 1960 level of $11 billion—with missiles continuing to command a larger share of the DOD dollar.

In his annual year-end review of the state of business, Cook predicted that R&D contracts "will be subject to increasing selectivity and . . . far more competition."

Recapping 1960, Cook said sales were broken down into $4.1 billion for missiles and $6.9 billion for aircraft for the 12 major airframe companies. The number of military aircraft fell to 1200 from the 1959 figure of 1700 units.

Cook noted that employment in the aerospace industry had continued to decline and was the lowest since 1955. The trend has been towards more highly skilled and higher-paid personnel, he said, with an average weekly wage increase of about 4% over 1959.

Along with this realignment of the labor force has come a 50% reduction in plant area requirements over the past three years but a high obsolesence rate and need for more sophisticated facilities, especially for R&D. The industry has had to invest almost $2 billion in new facilities in the past five years, Cook said, and this has contributed to the steady decrease in earnings. As a percentage of sales, earnings have dropped from 3.8 in 1955 to 1.5 in 1959; as a percentage of net worth, from 21.4 to 8 since 1955.

The aerospace backlog was estimated to be up a bit over last year. As of Sept. 30, 1960, orders on the books amounted to $12.5 billion, up $400 million from the 1959 figure. This increase was due to other military products which more than offset the decline in military aircraft procurement.

Moon Dust May be Thin Enough for Soft Landings

DUST ON THE MOON may be shallow enough in some places to permit safe landing by spacecraft.

Recent infrared "heat mapping" conducted by a Boeing Aero-Space Division team has brought evidence of considerable variation of the lunar dust layer. This is in direct contrast to the widely-held opinion that the moon was covered with a uniformly deep blanket of pulverized moon dust.

Boeing scientists based their conclusion on the fact that some moon craters retain solar heat much longer than do the plains or the waterless seas. The studies were conducted during the March 13 eclipse with the 73-in. reflecting telescope at Dominion Astrophysical Observatory, Victoria, British Columbia.

A second and confirming observation was made with the 60-in. telescope at Mount Wilson Observatory, Calif., Sept. 3, 4, and 5. A total eclipse occurred Sept. 5. More than 1 million square miles of the moon's surface were studied.

On each occasion, the moon was tracked by telescope while a radiometer measured total IR radiation received from a "sawtooth" scan of several parts of the moon's surface. Scanning was continued as the moon became enveloped in the earth's shadow and was cut off from solar light and heat for about three hours.

It was found that most of the moon cooled quickly to below 100° F, but the craters Tycho, Copernicus, Kepler and Aristarchus registered a temperature of about 0° F.

The Shorthill-Saari Thermal Contour maps, on which moon surface temperature differences discovered in the study are charted, follow with remarkable correlation the physical features of the moon.

The Boeing group pointed out that there are several other possible interpretations of this temperature change, including internal heating of radioactivity of materials in crater areas.

. . . Mariner Fly-bys

(Continued from page 15)

perature rises, and its resistance decreases. Since the compensating flake is shielded, its resistance is unaffected by the radiation.

As a result, the output voltage at the junction of the two flakes changes by an amount that is precisely proportional, over a tremendous dynamic range, to the power of the incident radiation.

Germanium-immersed thermistor detectors provide increased optical gain directly at the detector. The overall detectivity of the system is reportedly increased by a factor of about 3.5 simply by replacing the conventional unimmersed thermistor bolometer detector with the immersed detector having the same field of view.

The detector capsules are hermetically sealed and usually evacuated to eliminate "swish" noise from convection air currents. The hermetic sealing requires that IR transmitting windows be fitted, and that leads be brought through glass-to-metal seals in the base.

In common with most radiation detectors, the detectivity of thermistor bolometers increases with decreasing detector area. This is used to practical advantage by immersing the reduced active thermistor element at the rear of a germanium lens which focuses the incoming radiation upon the smaller detector.

For this job, germanium is used in preference to other materials because of its high index of refraction, its desirable spectral bandpass characteristics, and its adaptability to the manufacturing process.

Some invitations to bid have already been issued for design studies of the required instrumentation for the first *Mariner* flight and for the lunar soft-landing mission (Project *Surveyor*). Separate study contracts for payloads for later spacecraft have not been started. However, JPL has told some of its present contractors to extend their study efforts to include design conditions brought in by advanced spacecraft. ⌗

Segmented Success

THREE-SEGMENT, 15,000-lb.-thrust solid-rocket motor was fired successfully for 50 seconds recently by United Technology Corp. under a NASA-sponsored study. The space agency is considering spending more funds for further study.

. . . Brookings Report

(Continued from page 18)

policy-making body that President Eisenhower sought to abolish.

• **Working paper?**—It is understood that Johnson intends to staff the NASC with several dozen specialists in areas of government policy related to space. Thus it is possible the Brookings report might provide the council with a working paper on at least some phases of its responsibilities. Under the Eisenhower administration, the council has been merely a high-level committee that met infrequently.

By law, the council consists of the President, the secretary of state, the secretary of defense, the NASA administrator, the chairman of the Atomic Energy Commission, one other government member and three non-government members. The council now has a staff consisting of David Z. Beckler, acting secretary, and his secretary.

Michael agreed that many of the investigations proposed in the Brookings report might well be conducted by other government agencies than NASA. He emphasized that NASA had given his group no guidelines, other than to ask for recommendations on how it might comply with the provision of the Space Act calling for long-range planning.

Some proposed areas of investigation:

–Implications of satellite-based communications systems. Frequency allocation and sharing, international agreements on compatability of equipment components, priorities and cost-sharing arrangements for satellite, transmitter and receiver use, access to audiences, program content control, government-industry relationships, differing relationships in other countries, and the possibility that competing satellites might be launched by the USSR or another nation. Such studies might also be conducted by the Federal Communications Commission.

–Implications of a space-derived weather predicting system. Setting rules for exchange of information, even though weather information will be important militarily, cost-sharing arrangements and location of ground facilities, organizational arrangements, obtaining trained personnel, and implications for weather control, agriculture, tourism, water resources, transportation and disaster mitigation. Such studies might also be conducted by the U.S. Weather Bureau.

The report also proposes investigations of implications for international affairs, which might be conducted by the State Department, implications for industry, which might be conducted by the Commerce Department, and implications for scientific manpower and overall government operations, which might be conducted at White House level. ⌗

. . . European Research

(Continued from page 38)

the start, research in the advanced systems necessary to make possible the third part of the program.

• **Organization's advantages**—What are the advantages for Europe in having a permanent organization for space research? The direct technological and economic advantages will be: Coordination of buying, research and development, and of standardization will bring economy. Pooling of knowledge, skill and resources will make possible the economic development of facilities which might not be otherwise possible, e.g. advanced propulsion systems, highly stabilized platforms, satellite recovery, adequate tracking and date recovery. Centralization of the engineering skills required for payload engineering will be of great value to all, but especially scientists from the smaller nations. Centralization and pooling of data-processing equipment for use by all will make for efficient economic data handling.

There will be indirect benefits. The various advantages accruing from space research will be directly available to Europe. There will be much stimulation of technological research and of scientific research in universities.

Various fields of research may be mentioned, e.g.: a) technology of materials (such as special steels, new alloys, plastics) including studies of resistance to erosion, to high temperatures, to high vacua, and to radiation; b) miniaturization of electrical and mechanical devices; tracking and remote-control steering. ⌗

Thin Wall Thickness Gauge

A nuclear wall thickness Gauge is being marketed by Franklin Systems, Inc., Primary advantages over other previous methods are the extreme range of the instrument, which can measure from 0.02 to 0.150 inches; plus the fact that users do not require an AEC license.

With the Franklin gauge (Model 130), a measurement is made by placing an extremely thin (0.03 inch maximum diameter) radiation probe internally so that soft gamma radiation travels through the wall to be measured on the detector heads. A 50 Microcurie Radium D soft gamma radiation source and scintillation counting techniques are used to perform the measurements.

The range and accuracy of the gauge is within ± 5% of the wall thickness over a range of 0.015 to 0.120 in. However, for those that require finer tolerances, the gauge can be made with an accuracy of plus or minus 0.001 in. over an extended range of from 0.005 to 0.200 in.

Circle No. 225 on Subscriber Service Card.

High Vacuum Coupling

A line of Ultra-High Vacuum Couplings is being marketed by Cajon Machine Co. When using these couplings, no leaks are detectable or measurable on a Helium Mass Spectrometer with a sensitivity of 1.7×10^{-10} atmos. cc/sec/division. In addition to the simplicity of repeated assemblies, the all metalic design will permit operation at elevated temperatures.

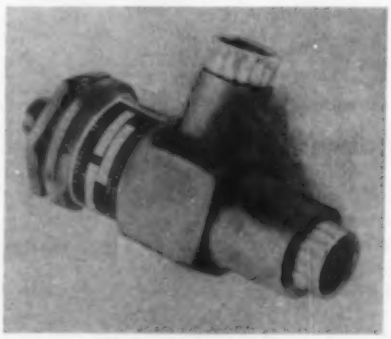
Circle No. 226 on Subscriber Service Card.

Hydraulic Relief Valve

An inverted design miniature relief valve from Benbow Manufacturing Corp. eliminates over-travel, chatter and slamming while maintaining desired system pressure.

Lightweight and miniaturized, these valves offer a wide variety of port sizes, male and female, straight flare or bulkhead. The valves exceed requirements of MIL-V-5523 with zero leakage internally.

Circle No. 227 on Subscriber Service Card.



Universal Tracer System

A 360°, two-axis, electro-hydraulic tracer system, featuring absence of contour limitation except as might be created by the cutting tool is available from Monarch Machine Tool Co.

The tracer head utilizes a variable reactance device which sends signals to an electronic control console for interpretation and amplification. Modulated signals from the console provide electro-hydraulic servo valve control for regulating oil flow to the hydraulic motors. The electronic equipment is in the form of fully transistorized plug-in modules.

Circle No. 228 on Subscriber Service Card.

High-Temperature Bearing

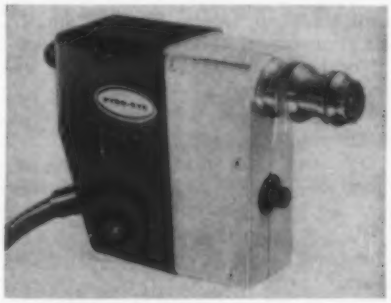
A precision ball bearing capable of operating at temperatures up to 575°F., without conventional lubrication has been developed by The Barden Corp.

Known as BarTemp, the bearing was designed for the needs of newer types of synchros, motors, blowers and fans that operate at far higher temperatures than their predecessors. Heretofore, bearings used in similar applications have been limited to operating temperatures of around 300°F.

Circle No. 229 on Subscriber Service Card.

Two-Color Optical Pyrometer

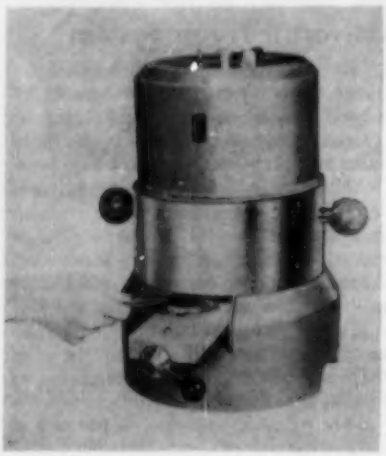
A two-color optical Pyrometer, PYRO-EYE, for completely automatic, continuous, measurement and control



of temperature in the ranges from 1400°F to 4500°F and from 750°C to 2500°C is available from Instrument Development Laboratories, Inc.

PYRO-EYE is available in two models: one for fixed mounting in production areas; the other, portable for laboratory use. Each of these models may be had in single, double or triple ranges. They measure temperatures at any distance from 20 inches to 60 feet from the target and are applicable to many processes.

Circle No. 230 on Subscriber Service Card.



Radioactivity Scaler

A laboratory instrument that transforms any scaler with a high voltage supply into a complete proportional counting system is available from Nuclear Measurements Corp.

Known as a proportional counter converter, Model PCC-11A, the unit connects to the scaler and plugs into any 110-volt circuit for precise detection and measurement of alpha, beta and gamma radiation in prepared samples. It discriminates between alpha and beta by high voltage setting only.

Circle No. 231 on Subscriber Service Card.

High Pressure Bleed Valve

A compact, light weight, leakproof and almost universally applicable high pressure bleed valve, P-416 type, is available from James, Pond & Clark, Inc. Purpose of this valve is to bleed off or blowdown high pressure gas or hydraulic systems.

Weighing only 0.06 lbs., operable at temperatures ranging from –65° to 300°F, and with an operating pressure range of from 0 to 3000 psi (proof pressure, 4500 psi; burst pressure over 7500 psi), the P-416 type is ideally suited for aircraft or missile installation.

Circle No. 232 on Subscriber Service Card.

Shock Testing Machine

Hardigg Industries are marketing shock testing machine for the drop testing of electronic devices and other fragile equipment up to 150 lbs. Machine will find fragility of product itself and can also be used to test ability of cushioning material to meet military and commercial specifications.

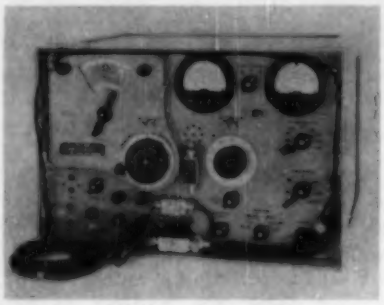
Shock Tester can be used in conjunction with the Hardigg Air Cushion, which produces a known reproducible shock pulse, with negligible rebound. The unique construction of the vertical guidance system and extremely rigid platens make for precise and convenient operation.

Circle No. 233 on Subscriber Service Card.

Flexible Signal Generator

A wide range of frequencies is available in a Signal Generator, No. 12/U, manufactured by Systems, Inc.

It is a precision test instrument designed to provide f-m and unmodulated r-f signals for various measurements and alignment. One of the two output cables supplies output voltage at nine different crystal-controlled frequencies which coincide with the intermediate frequencies used by various receivers to be tested. The second output cable supplies r-f output signals in a frequency range of 20 to 100 mega-



cycles in five bands. The r-f output is variable from 0.05 to 10,000 microvolts; the i-f output, from 0.5 microvolt to 1 volt.

Circle No. 234 on Subscriber Service Card.

Solid-State Transmitter

A compact, solid-state transmitter is available from Cubic Corp. The transmitter's circuitry incorporates a reactive multiplier which permits operating the basic oscillator at 56.25 mc. Through successive multiplier stages, this frequency is stepped up to the output frequency of 224 mc.

The transmitter is capable of 1 watt power output without exceeding the design limitations of the transistors, while short periods of 2.5- and 3-watt operation are also possible.

Circle No. 235 on Subscriber Service Card.

Function Generator

A function generator that provides any waveform at repetition rates down to one cycle every 200 seconds has been introduced by Advance Components Ltd., a British firm, through its U.S. distributor, General Measurements Co.

Called the SG88 V.L.F. Function

Generator, it is designed to fill the gap in the range of laboratory instruments currently available. It is intended for the solution of many simulation and computer design problems, for servo-system analysis, vibration testing and numerous similar applications. The unit eliminates the need for specially shaped and wound potentiometers and complex electronic wave-shaping circuits.

Circle No. 236 on Subscriber Service Card.

Servo-Valve Monitor

Model 1000-7 Servo-valve Monitoring System is available from Standard Controls, Inc.

It consists of three pressure transducers mounted on a thin manifold block which fits between the servo-valve being monitored and the hydraulic system manifold. A 3000 psi differential transducer gives a constant readout of the pressure difference between the two control ports of the servo-valve. A 3000 and a 300 psig transducer give constant indications of the pressure at the supply and return ports.

Circle No. 237 on Subscriber Service Card.

Conforming Polymer Seal

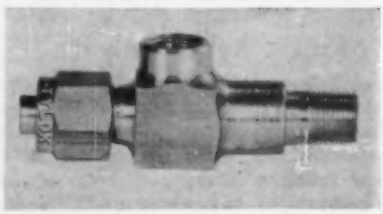
A spring-loaded self-conforming polymer seal for applications in reciprocating and low-speed rotary shafts under high pressure liquid and gas conditions is available from Del Manufacturing.

The seal combines polymer and spring steel in a principle insuring efficient operation over a temperature range of –320° to 500°F and under pressures up to 10,000 PSI.

Circle No. 238 on Subscriber Service Card.

Hydraulic Line T-Fitting

A Tylock 4-Seal T-Fitting which eliminates the need for adapters, con-



nectors and special fittings when applying pressure gauges or other instruments to hydraulic, pneumatic and process lines is available from C. B. Crawford Co. The fitting embodies four positive seals against pressure, temperature, vibration, surge, plus vibration dampener.

Circle No. 239 on Subscriber Service Card.

Two-Stage Hydraulic Pump

A two-stage hydraulic pump which delivers from 600 cu. in./min. at 100 p.s.i. to 50 cu. in./min. at 10,000 p.s.i., and weighs only 45 lbs., is available from the Precision Hydraulics Division of the Owatonna Tool Co.

The OTC "Vanguard" complete pumping unit is a quiet-operating, two-stage unit, driven by a universal motor, and consisting of a gear pump for the low-pressure stage and a five-cylinder axial-piston pump (which is supercharged by the gear pump) for the high-pressure stage.

Circle No. 240 on Subscriber Service Card.

Enclosed Induction Motor

Kearfott Division of General Precision, Inc. has available the BF 15-14 unit addition to its line of miniature and subminiature special motors. This motor is designed to function primarily as the driving unit for diverse fuel, air, and hydraulic pumps. The unit operates without diminished performance in severe environments.

Circle No. 241 on Subscriber Service Card.

Vertical Motor Generator

A vertical motor generator that eliminates shaft deflection and, therefore, vibration is available from Leach Corp.

The vertical unit is an addition to the Leach brushless synchronous line and will handle ratings from 125 KW to 175 KW.

A unique feature of the equipment is that the magnetic forces on the rotor produce a slight lifting action in the vertical direction, thus taking most of the load off the thrust bearings.

Circle No. 242 on Subscriber Service Card.

Magnetic Pilot Valve

A pilot valve for the actuation of large control valves is available from Marotta Valve Corp. The PLV-1 series is rated as a small flow, N.O. and N.C., 2 and 3-way, 3000 p.s.i.g., (10,000 p.s.i.g. burst) pneumatic service valve. Capacity is rated by an equivalent sharp edge orifice diameter of 0.030 in. Operated electrically on 18-30 VDC through either standard MS receptacle or pigtails.

Circle No. 243 on Subscriber Service Card.

Tiny Strain Transducer

Statham Instruments, Inc., is marketing a micro-miniature, flush-diaphragm, absolute-pressure transducer featuring high frequency response. Model P318 weighs 0.5 grams, with dimensions only 0.59 in. diameter by 0.050 in. thick.

Ranges for the P318 are 0-10 psi to 0-100 psi, available in absolute, gage

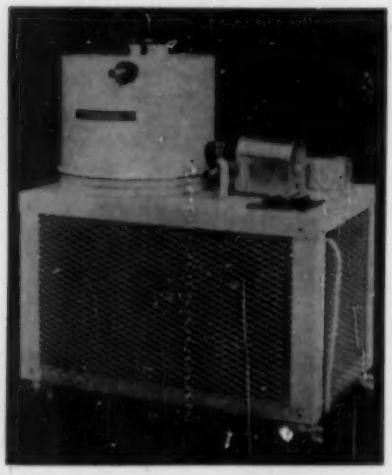
Spacecraft
LUNAR
PLANETARY • INTERPLANETARY
The National Aeronautics and Space Administration has assigned the Jet Propulsion Laboratory the responsibility for the Nation's Lunar, Planetary, and Interplanetary unmanned exploration programs.
Exceptional opportunities now exist for challenging positions in JPL's Space-Age Programs. Senior Development Engineers are needed to assume important responsibilities in the conceptual design and development of Lunar and Planetary Spacecraft within the Engineering Mechanics Division. Assignments will involve application of a broad spectrum of technical disciplines in the Aero-Mechanical Engineering Fields and will cover the full development cycle from engineering studies through vehicle testing, flight, and flight analysis.
Desirable backgrounds include an M.S. or higher degree in Aeronautical or Mechanical Engineering plus eight or more years of experience in development work. A thorough working knowledge and understanding of lightweight structure design and analysis, backed up by sound practical capabilities in dynamics and heat transfer is required. Additional positions in the fields of thermodynamics, heat transfer, dynamics, and structures are also available.
Qualified engineers are invited to forward their resumes and salary requirements to:
Jack M. Adams, Engineering Placement
jpl
CALIFORNIA INSTITUTE OF TECHNOLOGY
JET PROPULSION LABORATORY
ENGINEERING MECHANICS DIVISION
4800 OAK GROVE DRIVE
PASADENA, CALIFORNIA
Circle No. 6 on Subscriber Service Card.

or differential. Excitation is 15 volts. Output is 5 millivolts, full scale open circuit. The combined error due to nonlinearity and hysteresis is less than ±1.0% of full scale. Ambient temperature limits are −65° to +150°F.

Circle No. 244 on Subscriber Service Card.

Portable Lab Freezer

A low-temperature portable freezer that may be used as a dry air storage unit to −60°F, or as a circulating brine chilling device to −30°F, has been developed by Everlast Refrigeration Co.



The Everlast CIRCU-FREEZE, consists of a refrigerating unit with Freon 22, sealed compressor with a 1/3 hp motor, heavy stainless-steel drum, circulating pump, inlet and outlet fixtures, all mounted on a rigid frame with four rubber casters.

Circle No. 245 on Subscriber Service Card.

Rotary Component Balance

A dynamic balancer is available from Micro Balancing, Inc. Employing unconventional design techniques to achieve unprecedented accuracy the balance eliminates the erroneous effect of component vibration and substantially reduced the mass typical of conventional balancing machine frames.

The sensitivity of Model SU-7 is 0.00001 inch of measurable unbalance displacement.

Circle No. 246 on Subscriber Service Card.

Self Tuning Sonic Cleaner

Constant maximum efficiency can be had in the biggest cleaning operations with Powertron Ultrasonic Corp.'s Autosonic Series 1000 ultrasonic cleaners. The units, require no operator attention or tuning, and maintain optimum cleaning performance by means of an feedback transducer which compensates for all varying load conditions.

Circle No. 247 on Subscriber Service Card.

new literature

TRANSISTOR TESTER—Design specifications for the direct reading, variable duty cycle power transistor test set, Model NC-1, are available from Baird-Atomic, Inc. The technical data sheet gives full information on the new instrument, which can test both medium and high power transistors.

Circle No. 200 on Subscriber Service Card.

DOD DATA MICROREPRODUCTION—A six page folder discussing the new standards and specifications of the Defense Department's engineering data microreproduction system is available from Minnesota Mining and Manufacturing Co. Since the system is based upon the use of aperture cards as the standard medium for exchanging engineering data, an explanation of these cards is given along with illustrations.

Circle No. 201 on Subscriber Service Card.

SINGLE SHAFT GAS TURBINE—Bulletin 198, issued by Clark Bros. Co., describes the company's 9000 hp Single Shaft Gas Turbine. Primary design considerations of simplicity, low first cost, easy access to all areas and high reliability are first discussed, followed by a detailed description of major components.

Circle No. 202 on Subscriber Service Card.

ANGULAR ACCELEROMETERS—Features, applications and specifications of angular servo accelerometers manufactured by Donner Scientific Co. are included in a six-page brochure available from the firm. The units described are intended for control and measurement of missile and aircraft flight dynamics; structural analysis of induced angular acceleration; monitor and control of servo systems, and closing the loop in inertial guidance systems.

Circle No. 203 on Subscriber Service Card.

BALL BEARING BULLETIN—A newly revised publication, American Standard Requirements for Instrument Precision Ball Bearings, B3.10-1960, has been approved and published by the American Standards Association. This revision supersedes American Standard B3.10-1959, and redefines the characteristics of instrument precision ball bearings. A table of metric series has been included in the 1960 edition which reflects the work in progress on international modifications through agreements reached on international levels.

Circle No. 204 on Subscriber Service Card.

SUBMINIATURE - SWITCHES — A subminiature-switch Catalog No. 20-1 containing complete information on the expanded line of Unimax subminiature switches. Listings include high-temperature, sealed, environment-free, and MIL-Specification type switches as well as popular styles of phenolic-cased, push-button, toggle, and integral-actuator subminiature switches, and is available from Unimax Switch Division of W. L. Maxson Corp.

Circle No. 205 on Subscriber Service Card.

SEMICONDUCTORS—A 4-color brochure describing the complete line of Motorola industrial and military semiconductor products is available from the Semiconductor Products Division. The 12-page brochure lists key specficiations such as breakdown voltage, current capacity, operating temperatures, and power dissipation of the products Motorola offers. These include germanium power transistors, audio and switching transistors, silicon and germanium Motorola Mesa transistors, silicon rectifiers, and silicon Zener diodes.

Circle No. 206 on Subscriber Service Card.

THERMOSTATS—A bulletin describing the line of Certified Type MX thermostats featuring narrow differentials is available from Stevens Manufacturing Co. The bulletin contains photographs and drawings as well as latest ratings on both semi-enclosed and hermetically sealed types.

Circle No. 207 on Subscriber Service Card.

MOTOR GENERATOR EQUIPMENT—A series of product bulletins covering 400 cycle motor generator equipment has been newly issued by the Precision Power Division, American Electronics, Inc. The bulletins cover a line of brushless inductor alternators giving complete specifications as well as application data. Power outputs from ½ to 30 KVA are available in a wide variety of designs.

Circle No. 208 on Subscriber Service Card.

EXTRUDER REFERENCE CHART—A chart which tells at a glance how to solve the problems which might arise in the extrusion of CYCOLAC$_R$ plastic, has been released by Marbon Chemical Division of Borg-Warner Corp. The chart covers items such as variations in dimensions, pulsations, lumps, rough surfaces or porosity, and sheet appearance.

Circle No. 209 on Subscriber Service Card.

METAL BONDED DIAMOND TOOLS—A catalogue published by the Fish-Schurman Corp. describes the firm's metal bonded, diamond impregnated products including drills, wheels, blades, dressers and hones.

Circle No. 210 on Subscriber Service Card.

contracts

NASA

$1,384,780—Pittsburgh-Des Moines Steel, for high-temperature structures tunnel.

NAVY

Vitro Laboratories, for developing a standard procedure for measuring reliability of naval weapons systems. They are to establish a yard-stick for predicting how often, percentagewise, a missile system will fail to perform acceptably under specified conditions. Amount not disclosed.

$6,600,000—Hughes Aircraft Co., Culver City, Calif., for production of inertial guidance system for the *Polaris* missile.

$3,000,000—The Bendix Corp.'s Bendix Pacific Div., for antisubmarine warfare sonar equipment.

$70,000—Davidson Optronics, Inc., West Covina, Calif., for grinding, polishing and testing the blanks for astrometric Reflector telescope.

MISCELLANEOUS

General Mills, for development of a manipulator system to be used in remote handling of rocket fuels and rocket motors. Amount not disclosed.

$8,000,000—Convair, San Diego, for production of an advanced airborne mapping radar.

$3,000,000—Cubic Corp., San Diego, for tracking system for the Sahara Missile Range.

$2,000,000—Epsco, Inc., Cambridge, Mass., for telemetry development and manufacturing.

$1,381,105—Fairchild Semiconductor Corp., Mountain View, Calif., for high-reliability transistors. Subcontract from **Autonetics Division of North American Aviation.**

$700,000—Houston Fearless Corp.'s Uniconn Div., Los Angeles, for manufacturing gyros to be used in fire control systems. Subcontract from **Crosley Div. of Avco.**

$157,000—Harvill Corp., Los Angeles, for die-cast components on a classified military project. Subcontract from **Aerojet-General.**

ARMY

$30,766,492—George A. Fuller and L. E. Webb, Los Angeles, and Paul Hardeman, Inc., Stanton, Calif., for launching facilities in Kansas for the *Titan*.

$16,800,000—Sperry Utah Engineering Laboratory, for production of *Sergeant* missiles.

$3,000,000—Ford Motor Co.'s Aeronutronic Div., Santa Ana, for continuation of R&D of a *Shillelagh* weapon subsystem.

$1,600,000—General Electric's Missile and Space Vehicle Dept., Philadelphia, for fabrication and test of airframes for the surface-launched free flight rockets and Automet test vehicles.

$1,352,000—Sperry Rand Corp.'s Sperry Utah Engineering Laboratory, Salt Lake City, for additional R&D on the *Sergeant* missile system.

$1,321,590—Chrysler Corp., Detroit, for modifications on *Jupiter* missile components. (Two contracts.)

$1,077,438—Chrysler Corp., Detroit, for engineering on the *Redstone* missile system.

$250,000—Waltham Laboratories, Waltham, Mass., for studying the feasibility of a field army ballistic missile defense system.

AIR FORCE

RCA has received a "multi-million dollar" contract for development of a complete communication sub-system for the *Dyna-Soar* test program.

Minneapolis-Honeywell Regulator Co., for first-phase development of the inertial guidance system for the *Dyna-Soar* vehicle. Amount not disclosed.

$23,500,000—General Electric Co.'s Defense Systems Dept., for guidance system for the *Atlas*.

$12,000,000—Stromberg-Carlson, for communication systems for *Titan* bases.

$5,200,000—International Business Machines Corp., for a central computer for the SAGE program.

$2,409,000—Lear, Inc., Santa Monica, for automatic flight control system. (Two contracts.)

$2,000,000—Boeing Airplane Co., Wichita, for *Atlas* missile site installation hardware.

$2,000,000—Goodyear Aircraft Corp.'s Arizona Div., for overland *Atlas* missile trailers. Subcontract from **Convair.**

$1,700,596—Sprague Electric Co., North Adams, Mass., for capacitors to be used in inertial guidance and flight control equipment for the *Minuteman*.

$800,000—Telecomputing Corp., Los Angeles, for equipment used in conjunction with the *Minuteman*. Subcontract from **Autonetics.**

$750,000—International Resistance Co., Philadelphia, for metal film units for the *Minuteman*.

$487,069—Telecomputing Corp., Cook Batteries Div., for primary silver-zinc batteries to be used in flight control and guidance equipment of the *Minuteman*. Subcontract from **Autonetics Div., North American Aviation.**

$469,950—The Wah Chang Corp., Albany, Ore., for metal extrusion equipment. Two contracts, one for tungsten extrusion and the other for tantalum.

$370,000—Giannini Controls Corp., Duarte, Calif., for gyro systems for the *Titan*. Subcontract from **The Martin Co.**

$346,000—Lockheed Aircraft Corp., Marietta, Ga., for additional missile scoring systems.

$90,000—Lockheed Aircraft Corp., Burbank, for study aimed at determining the feasibility of logistics maintenance and support vehicles for space operation.

$78,000—Hughes Aircraft Co., Culver City, for development of a micro-miniature instrumentation packet to measure man's physiological responses to space flight stresses.

CLEAN, FAST and CONVENIENT

VEECO's VE-400 sets the standards for cleanliness, speed and convenience in high vacuum evaporators and experimental stations. Modular engineering permits you to select equipment to fill immediate needs with the freedom to add equipment as your requirements change.

VEECO manufactures a complete line of high vacuum equipment...Components, Leak Detectors, Evaporators, Systems . . . accepted as the *quality* line for over a decade.

For "400" Brochure or Complete Catalog, write Department 94D

Veeco

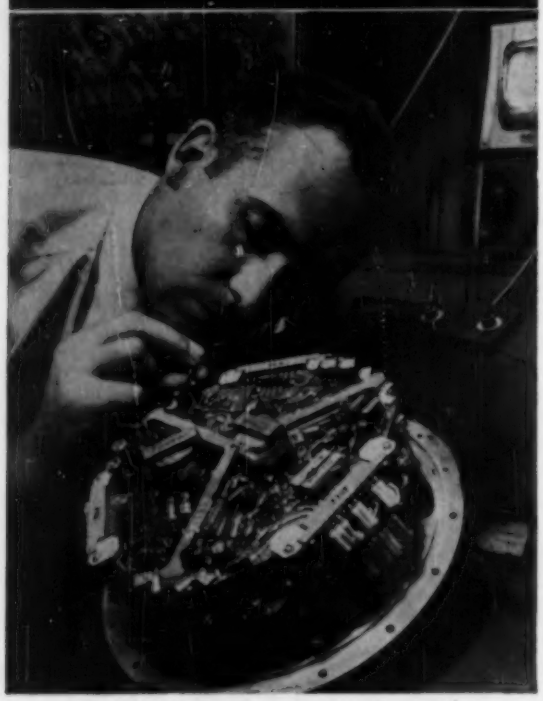
VACUUM-ELECTRONICS CORP.

Terminal Drive, Plainview, L. I., N.Y.

HIGH VACUUM & LEAK DETECTION EQUIPMENT

Circle No. 7 on Subscriber Service Card.

M/R EDITORIAL COVERAGE OF GUIDANCE



promotes product and capability sales to the $4 billion missile/space electronics market IN

missiles and rockets

4th ANNUAL ELECTRONICS ISSUE

PUBLISHING DATE: FEBRUARY 27, 1961
CLOSING DATE: FEBRUARY 6, 1961

Here Is Your Specific-Issue Tie-In.
The current annual electronics market is estimated at $4 billion—guidance alone accounts for $1.5 billion. M/R is presenting a complete 40-page editorial round-up of military guidance systems, PLUS regular weekly features; news; developments. Major emphasis will be in these areas:

- **Guidance and control market—present and future**
- **Guidance for satellite launch vehicles**
- **Guidance computer fabrication—radical technique used in development of Miniweld**
- **Analytical treatment of Dyna Soar guidance system**
- **Initial, mid-course and terminal guidance of Saturn boosted space vehicle**
- **First-time description of Minuteman guidance system**
- **All-inertial vs. radio command in ICBM systems**
- **Limiting problems and approaches towards gyroscope development**
- **Advanced guidance for solid-state computers in missile and space usages**

The immediate impact offered your advertising in M/R's Fourth Annual Electronics issue provides you with an exceptional opportunity to place your advertising message before over 30,000* paid subscribers—a long-life, desk-top reference which will guarantee maximum exposure to your products and capabilities. For further information, contact the M/R Regional Advertising Manager in your area.

*** Subject to audit**

M/R

missiles and rockets

AN AMERICAN AVIATION PUBLICATION
1001 VERMONT AVENUE, N.W.
WASHINGTON 5, D. C.

names in the news

ZANE

GARR

DICKEY

LAW

WALKER

Dr. Eric A. Walker: President of Pennsylvania State University, elected to Melpar, Inc.'s board of directors. Dr. Walker succeeded **Dr. Milton Eisenhower** as President of Penn State in 1956. He fills the vacancy left by the resignation of **John A. Mayer.**

Norman Kornetz: Joins The Siegler Corp.'s Bogen-Presto Division as director of engineering. Was formerly manager of Commercial and Military Engineering at Westinghouse Electric Corp.'s Television and Radio Division.

Dawes Walter and **Richard S. Lee:** Named manager-advertising and public relations and assistant advertising manager, respectively, at Pennsalt Chemicals Corp. Walter was formerly with Atlantic Refining Co. and Lee moves up from sales promotion manager, Industrial Chemicals Div.

Michael J. Joncich: Former general sales manager of Datex Corp., elected vice president. Prior to joining the firm in 1953 he was a sales engineer with Minneapolis-Honeywell.

John Zane: Appointed to the reactivated post of advertising and public relations director for Cubic Corp.

William Falstrom: Former chief mechanical engineer with the Canoga Corp., elected president of Cubic Corp.'s newly organized subsidiary, TEMEC, Inc.

Dr. Hector R. Skifter: Elected to the board of directors of American Research and Development Corp., succeeding **Horace S. Ford,** who will continue as a consultant. Dr. Skifter is president of Airborne Instruments Laboratory, a division of Cutler-Hammer, Inc., and a vice president and director of Cutler-Hammer.

John S. Harrison: Senior flight test group engineer for the *Atlas*, named base activation administration manager for Convair-Astronautics Division of General Dynamics Corp.

Dr. Trevor Law: Former member of the Research Dept. at Bell Telephone Laboratories, joins Motorola Semiconductor Products Division as senior engineer.

O. L. Lindahl and **D. C. Webster:** Vice presidents of Librascope Division, General Precision, Inc., elected to the board of directors of GPI.

John Huson: Joins Reflectone Electronics, Inc.'s Washington office as staff member for advanced simulator and training equipment requirements.

Donald E. Garr: Former manager of engineering operations for General Electric Co.'s armament and control section, joins Raytheon Company as corporate director of engineering.

Dale D. Myers: Vice president of North American Aviation's Space and Information Systems division, named weapon systems manager of the *GAM-77 Hound Dog* program.

Burton F. Drill: Rejoins Schaevitz Engineering as director of marketing, having been previously associated with the company as sales manager. Prior to his return he was sales manager for systems and instruments for the Bulova Watch Co.

Kendrick R. Wilson, Jr.: Elected chairman of the board and chief executive officer of Avco Corp., succeeding the late **Victor Emanuel. James R. Kerr** succeeds Wilson as president and **Col. Earl H. Blaik** is now chairman of the executive committee.

George J. Dickey: Former assistant to the executive vice president, appointed vice president and assistant general manager of the Stromberg-Carlson division of General Dynamics Corp.

Armand L. Klein: Joins Pacific Electro Magnetics Co., Inc., as marketing manager. Was formerly manager of Ampex Corp.'s custom products division.

J. N. Marshall: Elected manager, Advanced Systems Development Engineering, for the Electronic Data Processing Division of Radio Corporation of America.

Dr Alva C. Todd: Former staff member at the Illinois Institute of Technology's Armour Research Foundation; joins The Hallicrafters Co. as director of applied research for military products.

Dr. Edward H. Seymour: Director of research for Thiokol's Reaction Motors Division, advanced to general manager of the division, succeeding **Raymond W. Young,** who will take over responsibility in formulation and guidance of technical programs as director of advanced planning.

Charles A. Volz, Jr.: Former vice president and general manager, elected president of Olympic Products Company, Inc., succeeding **Joseph B. Schaefer,** now chairman of the board of directors.

Willis M. Hawkins: Appointed a vice president of Lockheed Aircraft Corp., assigned to the Missile and Space Division. He will continue as assistant general manager of the division.

Dr. Ben G. Forman: Joins National Resistance Corp. as corporate and new products division director.

Kenneth A. Waldron: Former manager, Government and Industrial marketing, C.B.S. Electronics ,oins R F Products, a division of Amphenol-Borg Electronics Corp. as vice president, marketing.

William B. Shimer: Formerly with Chrysler Corp., appointed director of manufacturing services for Borg-Warner Corp.

Charles W. Stephens: Named associate manager of the Advanced Power Systems Division of Electro-Optical Systems, Inc. He joined the firm in 1958 as a senior engineer, and more recently served as assistant to the manager of the Energy Research Division. Earlier, he was engaged in auxiliary power system analysis and development at Space Technology Laboratories.

Lowell Gene McClenning: Former advertising-PR director at Benson-Lehner, joins Telemeter Magnetics, Inc. as director of public relations and advertising.

letters

Command Changes

To the Editor:

"So great a soldier taught us there
What long-enduring hearts could do
In that world-earthquake, Waterloo."

So wrote Tennyson, and with due respects to General Wilson's scholarly background, the soldier was Wellington. Marlborough had been dead for nearly a hundred years.

Leslie W. C. S. Barnes
Ottawa, Ontario

To the Editor:

It is indeed a pleasure to learn of the depth of scholarship which some of our military leaders have attained, particularly General Wilson.

However, if the Duke of Marlborough were ever at Waterloo (Quatre Bras, actually) which is doubtful, it is likely that his tactics were amorous rather than military.

The Duke, whose great victory at Blenheim (Hoechstaedt) took place in 1704, would have been in rather poor shape to have met Napoleon at Waterloo in 1815 (he died in 1722).

Scholarship is certainly a worthy end in itself. It is particularly gratifying to have a scholar in a research position, since the two are mutually complimentary *(sic)* but at this rate, *"Nunquam facibimus"* (literally, "We will never make it").

William L. K. Schwarz
La Canada, Calif.

To the Editor:

Re your "Scholarly General, detailing tactics of Marlborough at Waterloo is quite a trick. Where can this be seen? The Duke of M. must really have been "getting along in years" by 1815!

(Name indecipherable)
Ottawa, Ontario

P. S. Could a placed called Blenheim about the year 1704 be involved?

M/R's brief profile of Lt. Gen. Roscoe C. Wilson, Air Force R&D chief, on page 13 of the Dec. 5 issue, said "he can explain in detail the tactics of Marlborough at Waterloo." However, General Wilson still gets A in history. The F goes to the chap who passed on the report to M/R, which trustingly refrained from going back to its history book. Wilson is pretty good on Marlborough at Blenheim, too.—Ed.

A top expert on Russia tells why the Soviets lead in rocketry — and how we can close the gap now —

RUSSIA'S ROCKETS AND MISSILES

by Albert Parry
Contributing Editor,
Missiles and Rockets

One of the first experts to predict Sputnik I describes Soviet progress and potential — how Sputniks and Luniks were developed; latest status of East-West rivalry; contributions of German scientists to Soviet success; details about the Russian IRBM now being installed on Red submarines. *"Brings information that has not been available before."*—from the introduction by WILLY LEY

$4.95 at all booksellers, or from
DOUBLEDAY & COMPANY, Inc.
Garden City, N. Y.

Circle No. 8 on Subscriber Service Card.

NASA's Space Exhibit

To the Editor:

Your views on the recent NASA exhibit in Montreal of U.S. space progress, as expressed in the M/R Dec. 5 editorial ("Exhibiting Our Space Achievements") are warmly appreciated. The fact that you speak as a professional communicator on the functional usefulness of good exhibits as a means of informing the world publics regarding the U.S. space science and exploration programs gives valuable authority to your statements.

In light of your remarks, I hope you do not feel that we are ungracious in noting for your attention the following:

A. Contrary to the impression one might receive from the editorial, NASA top management gave the exhibit project ready approval and prompt and adequate funding.

B. The exhibit is in no danger of ending its life with the showing in January in the Chicago Museum of Science and Industry. It will be available to qualified exhibitors as long as it lasts. Also, at least one additional exhibit along the lines of the Montreal presentation will start on tour in Fiscal 1961 and several copies of smaller exhibits will be made available for public showings. We have approved plans for material expansion of the NASA exhibits program in FY 1962, subject, of course, to availability of funds.

C. We are not at all unsure about accepting invitations to present NASA exhibits at the British Columbia Trade Fair in May and the American Rocket Society's New York meeting in October, 1961. We plan to show in Vancouver and are committed to a substantial exhibit at the ARS meeting.

Again, let me thank you not only for your appreciation of the value of such efforts as the Montreal exhibit but also for your tribute to its design and execution, which were the work of talented and dedicated public servants.

Shelby Thompson
Director, Office of Technical Information and Educational Programs
NASA
Washington, D.C.

M|R did not mean to imply a lack of NASA management support for the exhibit, but rather a lack of funds; we are happy to learn of continuing support and showings.—Ed.

Irish Mist

To the Editor:

In the Oct. 24 M/R COUNTDOWN you state: "A major space research center for Western Europe is being established at Queen's University in Northern Ireland. The center is being built in cooperation with ARPA . . ."

This statement represents a very inaccurate picture of the actual contract with Queen's University, Belfast. Actually, the investigation to which you refer is being carried out under a U.S. Navy contract. The Advanced Research Projects Agency (ARPA) has made the funds available, but U.S. Navy personnel are responsible for the technical guidance and administration of the contract.

Projects which have been assigned to ARPA by the Secretary of Defense include those involving (a) military space technology, (b) advanced ballistic missile defense, and (c) *general science*. The projects fall into three categories: (1) research not identified with a specific military requirement, (2) research which relates to the primary functions of two or more military services, or (3) research which for other reasons is better handled by an agency other than one of the military services.

The contract at Queen's University is strictly a basic research contract, not identified with a specific military requirement. Studies are to be directed to the treatment of atomic and molecular processes by approximate methods. Absorption of X-radiation, electron capture, ionization by electrons and by heavy particles are some of the processes which will be studied. Much of the work involves tedious numerical calculations, hence a small digital computer is required.

To imply the establishment of a "major space research center for Western Europe" from this Queen's University basic research contract, therefore, is considered to be improper.

W. B. Heidt, Jr., Cmdr., USN
Director, U.S. Navy European Research Contracts Program
London

The Real Echo?

To the Editor:

Page 13 of the Nov. 28 M/R states in

part, "The *Echo* vehicle has been visible for a few minutes during recent midnight passes . . . It should again be visible in about two weeks."

This is rather unsettling news if you mean the balloon itself. I have been observing early evening passes of an object I believed to be *Echo*, beginning the evening of Nov. 17-18 at 6:10 P.M. EST. The most recent sighting was the evening of Saturday, Dec. 3-4 at 6:10 P.M. EST. Times given here mean time when object was first seen upon rising and are probably accurate only to within a minute or two, as I have no special equipment. In all, 10 passes were observed on 7 evenings, as 2 consecutive passes were observed on 3 evenings. Those sightings which occurred after 7 P.M. were terminated when the object entered the earth's shadow, the position of the eclipse depending upon the time.

This object resembles the *Echo* balloon in its visual appearance and in its various trajectories across the sky. Five distinct and separately oriented orbital crossings have been observed. Also, the period between two consecutive appearances in one evening (2 hours) and its arrival on two consecutive evenings (now about 29 minutes earlier in 24 hours) resembles that of *Echo*. I know of no other orbiting object which has the same period and magnitude.

Would you please tell me: is the object I have been observing so diligently really *Echo*?

Joan Siedenburg
Cortland, N.Y.

It very probably is. The news item meant that the balloon (that is, the vehicle) would soon be visible again during midnight passes. It has been visible during early evening passes for some weeks.—Ed.

Regulus' Record

To the Editor:

Just finished reading a bit about the phase-out of the Air Force's *Snark* after a total of 80 flights. In this era of exotic space probing it seems worthwhile to mention that the Navy's first operational submarine-launched missile, *Regulus I*, is still going strong with over 1000 launchings under its belt. This all-weather, rough and ready bird has been launched in desert-hot areas, from icy submarine decks and, in one specific instance, from a heavily rolling submarine in a State 5 sea (I know, because I launched it).

Reliability and performance have been noteworthy in this now-out-of-produciton Chance Vought missile, as compared with other surface-launched birds. Successful consecutive flights for the recoverable training version (FTM) have been consistently high, with, I believe, 20 flights the current individual record.

The Navy's *Regulus* Submarines (SSG's) are currently aiding in keeping the peace in the Far East from their base at Pearl Harbor and doing a mighty fine job of it.

R. E. Kutzleb
Key West, Fla.

—when and where—

JANUARY

Symposium on Thermoelectric Energy Conversion, Joint Technical Society, DOD, Statler Hilton Hotel, Dallas, Jan. 8-12.

Seventh National Symposium on Reliability and Quality Control, Bellevue-Stratford Hotel, Philadelphia, Jan. 9-11.

International Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit, Jan. 9-13.

Symposium on Space Instrumentation, IRE, PGSET, Washington, D.C., Jan. 16-17.

American Astronautical Society, Annual Meeting, Sheraton Dallas Hotel, Dallas, Jan. 16-18.

Winter Instrument-Automation Conference and Exhibit, Instrument Society of America, Jefferson Hotel and Kiel Auditorium, St. Louis, Jan. 17-19.

29th Annual Meeting, Institute of the Aeronautical Sciences, Hotel Astor, New York City (Honors Night Dinner Jan. 24) Jan. 23-25.

1961 Plant Maintenance and Engineering Conference, International Amphitheatre, Chicago, Jan. 23-26.

American Mathematical Society, National Meeting, Willard Hotel, Washington, D.C., Jan. 24-27.

Society of Plastics Engineers, Annual Technical Meeting, Shoreham and Sheraton Park Hotels, Washington, D.C., Jan. 24-27.

American Institute of Electrical Engineers, Winter General Meeting, New York City, Jan. 29-Feb. 3.

American Society for Testing Materials, Committee Week, Netherland Hilton Hotel, Cincinnati, Jan. 30-Feb. 2.

American Physical Society, New Yorker Hotel, New York City, Jan. 31-Feb. 4.

FEBRUARY

Institute of Radio Engineers, Prof. Group on Military Electronics, Los Angeles, Feb. 1-3.

American Rocket Society, Solid Propellant Rocket Conference, The Hotel Utah, Salt Lake City, Feb. 1-3.

Institute of Radio Engineers, International Solid-State Circuits Conference, 8th Annual Meeting, Sheraton Hotel and University of Pennsylvania, Philadelphia, Feb. 15-17.

American Society for Metals, Albuquerque and Los Alamos Chapters, Recent Developments in Materials for Nuclear Applications, University of New Mexico, Albuquerque, Feb. 16-17.

American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, St. Louis, Feb. 19-23.

Pacific Electronic Trade Show, Great Western Exhibit Center, Los Angeles, Feb. 26-Mar. 1.

American Institute of Chemical Engineers, National Meeting, Roosevelt Hotel, New Orleans, Feb. 26-Mar. 1.

Association of Iron and Steel Engineers, Los Angeles, Feb. 28-Mar. 2.

Western Joint Computer Conference, Los Angeles, Feb. 28-Mar. 1.

Advertisers' Index

Aerojet-General Corp., Sub.-General Tire & Rubber Co. 8
Agency—D'Arcy Adv. Co.

AiResearch Mfg. Co., Div.-The Garrett Corp. 3
Agency—J. Walter Thompson Co.

American Telephone & Telegraph Co. 4
Agency—N. W. Ayer & Son, Inc.

Avnet Electronics Corp. 2
Agency—Dale & Finkels, Inc.

Cannon Electric Co. 30
Agency—Anderson-McConnell Adv. Agency, Inc.

Doubleday & Co., Inc. 48
Agency—Franklin Spier, Inc.

Jet Propulsion Lab. 43
Agency—Barton A. Stebbins

Lockheed Aircraft Corp., Missiles & Space Div. 6, 7
Agency—Hal Stebbins, Inc.

New Departure Div.-General Motors Corp. 22
Agency—D. P. Brother & Co.

Rocketdyne, a Div. of North American Aviation, Inc. 10, 11
Agency—Batten, Barton, Durstine & Osborn, Inc.

Snap-Tite, Inc. 52
Agency—Lando Adv. Agency, Inc.

Veeco Vacuum-Electronics Corp. 45
Agency—Duncan-Brooks, Inc.

M/R BUSINESS OFFICES

Washington 5, D.C.—1001 Vermont Avenue, NW; STerling 3-5400
Edward D. Muhlfeld, Publisher

New York 17, N.Y.—20 East 46 Street; YUkon 6-3900
Paul B. Kinney, Eastern Advertising Manager
Paul N. Anderson

Los Angeles, California—8929 Wilshire Blvd.; OLeander 5-9161
James W. Clear, Western Advertising Manager
Edwin J. Denker, Jr.

Detroit 2, Michigan—412 Fisher Building; TRinity 3-2555
Kenneth J. Wells

Chicago 2, Illinois—139 N. Clark St.; Central 6-5804
R. Lenn Franke

Dallas 24, Texas—202 Wynnewood Professional Building
John L. Hathaway

Miami, Florida—208 Almeria Ave., Coral Gables
Richard D. Hager

London, W.1, England—28 Bruton Street; Grosvenor 8356
Norall and Hart

Geneva, Switzerland—10 Rue Grenus; Geneva 321044

Paris, France—11 Rue Condorcet; TRU 15-39

Frankfurt/Main, West Germany—Friedrich-Ebert-Anlage 3

A New Boss for the Space Program

BY NAMING Lyndon Johnson chairman of the National Aeronautics and Space Council, Mr. Kennedy has in effect made the Vice President-elect responsible for the nation's space program.

Coming as it does, one of Kennedy's earliest major appointments, the designation of the country's No. 2 executive to the newly created post indicates two things clearly.

–The President-elect fully appreciates the importance of the U.S. space program and is determined to push it vigorously—as he said he would during his campaign.

–He wanted and has chosen a strong forceful man to head it.

As Chairman of the Senate Space Committee, Lyndon Johnson is thoroughly familiar with the strengths and weaknesses of our space exploration efforts. From the Congress he could only advise. From the executive branch he can direct, with the President's approval. And the Council—if it operates as the Congress intended it to operate—can decide whether or not we have a real space program, what its size and scope shall be, and who carries it out.

The Council is composed of the President, the Secretaries of State and Defense, the Administrator of NASA, one other selected federal official and three non-governmental members.

By executive action Mr. Kennedy has named Johnson his alternate on the Council, presumably to carry out all the duties enumerated. Some "tidying-up" legislation may be forthcoming to make this delegation of authority completely legal, but there is plenty of precedent for initiating it by executive action.

Under President Eisenhower the Council has met a few times to approve administrative matters but has never functioned as the law intended.

Nor, for that matter, did President Eisenhower. In all fairness, however, it would have been unrealistic to expect the President of the United States to perform the detailed duties laid out for him in the Space Act. Our complaint with Mr. Eisenhower in this case is not that he failed to carry out the intent of the act—but that he failed to delegate the task to someone who would.

We have had, actually, not a space program but a space wrangle.

Now—if the President-elect is sincere, as we believe he is, in giving his No. 2 man a mandate to boost the United States into first place in the space exploration race—we can move along.

We can have a space program for peaceful purposes, but we can also quit pretending there is no military application in space.

We can carry out the projects designed to help all mankind and at the same time take the military action necessary to ensure that we have the freedom of space which will guarantee our right to explore peaceably.

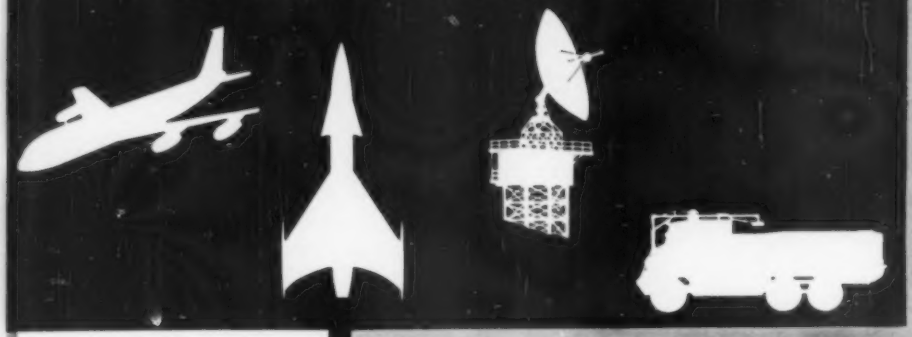
Because human nature is as it is and because freedom must always be protected, the United States must have certain military capabilities in space—capabilities in reconnaissance, in defense, in offense and in support for all three.

At the moment we are working on only one —reconnaissance. We are dedicated to a "step-by-step" operation, except that some of the steps are missing.

To catch up we need a real and complete program which is understood by both government and industry. We need a great deal of basic and applied research in a joint effort—an effort which will permit us to move forward by quantum leaps instead of lagging steps. There is nothing lacking in the capabilities of the nation. The lack has been in the leadership.

Clarke Newlon

WHICH PICTURE FITS YOU BEST?



Do you manufacture aircraft, missile, electronic or ground support equipment?

Writing & Editing

Parts Listing

Illustration

Reproducible Copy

Spare Parts Documentation

No matter what your answer, you must be interested in reliability in service. But, in the long run, reliability in service requires reliability in service information.

This is where we come in. Our business is the preparation of the technically adequate and accurate service manuals demanded by the military . . . and desired by the manufacturer to maintain his reputation for equipment reliability.

Spruce Technical Publications can provide complete services for many types of military and commercial manuals, and for diverse military technical documentation. This is another service of American Aviation Publications.

Brochure available on request

SPRUCE TECHNICAL PUBLICATIONS
608 South Dearborn Street
Chicago 5, Ill.

A subsidiary of . . .

AMERICAN AVIATION PUBLICATIONS, INC.

Hey, Herman... Snap-Tite valved couplings come in big sizes too!

There's a size and type to handle almost anything that flows

Snap-Tite can provide the right size valved coupling for most any use . . . with quick off-on action wherever coupling or shut-off is required.

"H" series valved couplings for high pressure applications. High resistance to heavy line surge. Sizes from 1/8" through 6". Larger sizes on special order.

"IH" series valved couplings for greater impact in air lines. 1/8" through 1/2".

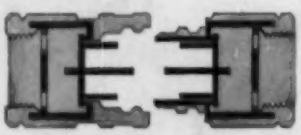
"E" series valved couplings for vacuum and very low pressure. Recommended for gravity flow. Sizes from 1/8" to 6". Larger sizes on special order.

"T" series valved couplings for hard to handle fluids. The only valved quick-disconnect couplings now on the market for fluid temperatures from −40°F to +400°F. Sizes from 1/2" through 3".

Snap-Tite valved couplings are available with two-way or one-way automatic line shut-off. They are normally furnished in alloy steel. Also available in brass, aluminum, or stainless steel with a variety of finishes.

TO USE SNAP-TITE VALVED COUPLING:

CONNECT—Full flow instantly



DISCONNECT—No flow instantly

Write for Snap-Tite Catalog No. 58 for more information on Snap-Tite valved couplings.

☆ Snap-tite

UNION CITY, PA

87-90-01

Circle No. 9 on Subscriber Service Card.

flows

. . . with

stance to
rder.
ugh ½"
mended

d quick-
n −40°F

atic line
in brass,

ite

CITY, PA